

***Work Plan for Supplemental Site Inspection
(SOC 4) and Remedial Investigation (SOC 5)***

***UMore Mining Area
Dakota County, Minnesota***

***Prepared for
University of Minnesota***

August 20, 2009



UMP005470

***Work Plan for Supplemental Site Inspection
(SOC 4) and Remedial Investigation (SOC 5)***

***UMore Mining Area
Dakota County, Minnesota***

***Prepared for
University of Minnesota***

August 20, 2009



4700 West 77th Street
Minneapolis, MN 55435-4803
Phone: (952) 832-2600
Fax: (952) 832-2601

**Work Plan for Supplemental Site Inspection (SOC 4) and Remedial
Investigation (SOC 5)
UMore Mining Area
Dakota County, Minnesota**

August 20, 2009

Table of Contents

Executive Summary	vi
1.0 Introduction.....	1
1.1 Purpose.....	2
1.2 SSI/RI and other UMA Investigations	3
1.3 Project Roles	3
2.0 Site Background and Physical Setting.....	5
2.1 Location & Current Conditions	5
2.2 Physical Setting.....	6
2.2.1 Climate and Hydrology.....	6
2.2.2 Soils	6
2.2.3 Surface Water.....	6
2.2.4 Geology.....	6
2.2.4.1 Unconsolidated Deposits.....	6
2.2.4.2 Bedrock	7
2.2.5 Hydrogeology	7
2.3 Operational History.....	7
2.3.1 SOC 4.....	7
2.3.2 SOC 5.....	8
2.3.2.1 DNT Storage Bunkers	8
2.3.2.2 University Use.....	9
2.4 Previous Investigations	9
2.4.1 Petroleum Release in SOC 5.....	9
2.4.2 Pesticide Release in SOC 5.....	9
2.4.3 Phase I Environmental Site Assessment – UMore Park	10
2.4.4 USACE Investigations of the Former GOW.....	10
2.4.4.1 SOC 4 (AOC 3 DA-1).....	10
2.4.4.2 SOC 5 (AOC 5).....	11
2.4.5 Additional Historical Information Review and Site Reconnaissance	11

2.4.5.1	Evaluation of Sites of Concern.....	12
2.4.5.2	Historical RECs Listed as Closed with No Evidence of Remaining Impacts	13
2.4.6	Groundwater Assessment Work Plan for EIS.....	13
3.0	Initial Evaluation	15
3.1	Conceptual Release Models, Operable Units, and Constituents of Concern	15
3.1.1	SOC 4 Conceptual Release Model and Operating Units	15
3.1.1.1	OU1 - Former DNT Loading Platform and Drainage Ditch	16
3.1.1.2	OU2 – Settling Basin and Drainage Ditch South of SOC 5 (AOC 3 DA-1) .	17
3.1.1.3	OU3 – Surficial Debris Area	17
3.1.2	SOC 5 Conceptual Release Model and Operating Units	18
3.1.2.1	OU1 – DNT Storage Bunkers (Buildings 260a through 260h)	19
3.1.2.2	OU2 – Pesticide Release Area.....	19
3.1.2.3	OU3 – Petroleum Release Area.....	20
3.1.2.4	Other SOC 5 Sampling.....	20
3.2	Preliminary Exposure Pathway Assessment	21
3.3	Potentially Applicable or Relevant and Appropriate Requirements and to-be-Considered Criteria	21
3.4	Preliminary Assessment of Risk to Human Health.....	21
4.0	Work Plan Rationale	23
4.1	Data Quality Objectives	23
4.2	Sampling Approach	24
4.2.1	General	24
4.2.1.1	Soil Sampling Locations	24
4.2.1.2	Soil Sampling Depths.....	24
4.2.1.3	Subsurface Structures	25
4.2.1.4	Groundwater.....	25
4.2.2	Operable Units	25
4.2.2.1	SOC-4 – OU1 – Former DNT Loading Platform and Drainage Ditch.....	25
4.2.2.2	SOC 4- OU2 – Settling Basin and Drainage Ditch South of SOC 5 (AOC 3 DA-1)	26
4.2.2.3	SOC 4- OU3 – Surficial Debris Area	26
4.2.2.4	SOC 5- OU1 DNT Storage Bunkers (260a through 260h).....	26
4.2.2.5	SOC 5- OU2 Pesticide Release Area	27
4.2.2.6	SOC 5- OU3 Petroleum Release Area	27
4.2.2.7	SOC 5- Other Areas	27
5.0	Investigation Tasks.....	29
5.1	Sampling	29
5.1.1	Surface Soil Samples	29
5.1.2	Soil Borings	29
5.1.3	Groundwater Sampling in Soil Borings	30

5.1.4	Groundwater Sampling in Water Supply Wells.....	30
5.1.5	Test Trenching	30
5.1.6	Composite Sampling for Pesticides	31
5.2	Non-Sampling Investigation Tasks.....	32
5.2.1	Surveying	32
5.2.2	Well Survey	33
6.0	Reporting and Schedule.....	34
6.1	Supplemental Site Inspection and Remedial Investigation Report	34
6.2	Schedule and Timeline.....	34
7.0	References Cited.....	36

List of Tables

Table 1	Focused Site Inspection Sampling Results
Table 2	Conceptual Release Model, Routes of Migration, and Potential Exposure Pathways
Table 3	Potentially Applicable or Relevant and Appropriate Requirements and To-Be-Considered Criteria
Table 4	Soil and Groundwater Sampling Plan

List of Figures

Figure 1	Site Location
Figure 2	SOC #4 and SOC #5
Figure 3	UMA Surface Soils
Figure 4	Surface Water
Figure 5	Generalized Stratigraphic Column
Figure 6	Groundwater Flow Map (Uppermost Saturated Unit)
Figure 7	General Summary of Previous Sampling Results
Figure 8	Former DNT Loading Platform and Drainage Ditch (SOC #4) Sampling Locations
Figure 9	Central Services Station/Former DNT Bunkers (SOC #5) Sampling Locations
Figure 10	Soil Sampling Approaches
Figure 11	Water Supply Well Sampling Locations

List of Appendices

Appendix A	Historic Information: SOC 4 and 5
Appendix B	Updated Phase I Environmental Site Assessment Materials

List of Acronyms

AES	Agricultural Experiment Station (University of Minnesota)
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
AST	Above Ground Storage Tank
bgs	Below ground surface
COC	Constituent of Concern
DBP	Di-n-butyl Phthalate
DNT	Dinitrotoluene
DNR	Minnesota Department of Natural Resources
DPA	Diphenylamine
DRO	Diesel Range Organics
DQO	Data Quality Objective
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
FSI	Focused Site Inspection
FSP	Field Sampling Plan
GPS	Global Positioning System
GOW	Gopher Ordnance Works
GRO	Gasoline Range Organics
HRL	Health Risk Limit
kg	Kilograms
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
mg	Milligrams
MPCA	Minnesota Pollution Control Agency
MSL	Mean sea level
PA	Preliminary Assessment
PACM	Potentially Asbestos Containing Material

PAH	Polycyclic Aromatic Hydrocarbon
PID	Photoionization Detector
PPM	Parts per Million
Phase I	Phase I Environmental Site Assessment
QAPP	Quality Assurance Project Plan
REC	Recognized Environmental Condition
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
SSI	Supplemental Site Inspection
SLV	Soil Leaching Value
SOC	Site of Concern
SRV	Soil Reference Value
SVOC	Semi-volatile Organic Compound
TBC	To-be-considered Criteria
UMA	UMore Mining Area
UMore Park	University of Minnesota Outreach, Research and Experimentation Park
ug	Micrograms
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
UST	Underground Storage Tank
VOC	Volatile Organic Compound

Executive Summary

This Work Plan (Plan) identifies and describes the investigation tasks that will be used to characterize soil and groundwater at two Sites of Concern (SOCs) located in the UMore Mining Area (UMA), Dakota County, Minnesota (Figure 1). The goal of the investigation is to evaluate the nature and extent of environmental impacts related to operations that occurred at the subject SOC during and after operation of the former Gopher Ordnance Works (GOW). The results of the investigation will be used to develop appropriate response actions to address impacts in the SOC prior to commencement of planned sand and gravel mining operations.

The SOC that is addressed by this Work Plan includes the Former DNT Loading Platform and Drainage Ditch (SOC 4) and the Central Services Station/Former DNT Storage Bunkers (SOC 5). Due to their involvement with GOW operations, a portion of SOC 4 (referred to as AOC 3 DA-1 by the U.S. Army Corps of Engineers) and all of SOC 5 (referred to as AOC 5 by the U.S. Army Corps of Engineers) have previously been the subjects of a Preliminary Assessment (PA) and a Focused Site Inspection (FSI) conducted by the U.S. Army Corps of Engineers (Army) under the Formerly Used Defense Site (FUDS) Program.

The planned scope of work includes the following components:

- Collection of soil samples from direct push soil borings, surface sample locations, and test trenches.
- Collection groundwater samples from direct-push boring borings and nearby water supply wells.
- Conducting a survey of wells with a four-mile search radius.
- Summarizing the results of the investigation in a report and identifying supplemental investigation and/or potential response actions to address identified releases.

1.0 Introduction

This Work Plan has been prepared on behalf of the University of Minnesota (University) by Barr Engineering Co. (Barr) to describe the continuation of environmental investigations at two Sites of Concern (SOCs) in the UMore Mining Area (UMA), located in Dakota County, Minnesota (Figure 1). The UMA consists of the approximate western one-third of the University of Minnesota Outreach, Research, and Experimental Park (UMore Park) property. The UMA is being proposed for future sand and gravel mining and is the subject of an Environmental Impact Statement (EIS) currently in preparation by the University.

The two subject SOCs, referred to as the Former DNT Loading Platform and Drainage Ditch (SOC 4) and the Central Services Station/Former DNT Storage Bunkers (SOC 5), were ancillary (non-production) areas for the Gopher Ordnance Works (GOW), a smokeless gunpowder production facility that was briefly operated during World War II on the UMore Park property. A portion of SOC 4 and all of SOC 5 were identified as Areas of Concern (AOCs) AOC 3 DA-1 and AOC 5, respectively, in a Preliminary Assessment (PA) conducted by the U.S. Army Corps of Engineers (Army; USACE, 2006). Both AOC 3 DA-1 and AOC 5 were carried forward for further investigation in a Focused Site Inspection (FSI; Bay West, 2009). The FSI included the collection and analysis of four soil samples and one groundwater sample in AOC 3 DA-1 and twenty-four soil samples and one groundwater sample in AOC 5. Based on the results of the FSI, the Army concluded that releases of hazardous substances to soil occurred in AOC 5. In a comment letter dated August 8, 2008, the University concurred with the Army's conclusion that further investigation of AOC 5 was warranted (Barr, 2008a). The Army's report did not recommend additional sampling at AOC 3 DA-1.

The term 'Site of Concern' (or SOC) is used in this document, rather than Area of Concern (AOC) as used by the Army, to maintain a distinction between the two investigations, and the slightly different boundaries selected for the two investigations. This is because the boundary of SOC 4 encompasses all of AOC 3 DA-1 and additional property to the north. The boundary of SOC 5 is generally consistent with the boundary of the Army's AOC 5, but does not extend as far into the farm fields located east and west of the DNT bunkers. The revisions to the SOC boundaries are based on report research and field reconnaissance and serve to focus the investigation on the area where releases to soil and subsequent runoff may have occurred. The SOC boundaries are shown in relation to the Army's AOC boundaries on Figure 2.

1.1 Purpose

This investigation builds upon the results of the FSI and other previous investigations so that the University can assess the nature and extent of releases of hazardous substances or petroleum products within SOC 4 and 5. It is likely that additional investigation may be needed to supplement the data collected under this Work Plan in one or both SOC 4 and 5. The planned investigation includes conducting a Supplemental Site Inspection (SSI) of SOC 4 and a Remedial Investigation (RI) of SOC 5. The primary objective of the SSI in SOC 4 is to collect and analyze soil and groundwater samples to determine if there is evidence of a release and, if a release is present, to evaluate risks to human health. The objective of the RI in SOC 5 is to collect sufficient data to characterize the nature and extent of environmental impacts and to support the development of response actions (if needed), and to prepare for future sand and gravel mining operations.

The Army is responsible for releases of hazardous substances and petroleum products that occurred in the UMA as a result of the GOW. However, to properly prepare for the planned sand and gravel mining operations, the University is moving forward to conduct this SSI/RI of SOC 4 and 5 to provide information for the Environmental Impact Statement (EIS) that is currently in preparation.

This SSI/RI Work Plan (Work Plan) includes the following sections:

- Section 1: Introduction - including the purpose of the SSI/RI (Investigation), a discussion of how the Investigation relates to the investigation of other SOC 4 and 5, and an overview of the University and Minnesota Pollution Control Agency (MPCA) staff roles.
- Section 2: Site Background and Physical Setting – including a description of the physical setting, operational history, and previous investigations conducted within SOC 4 and 5.
- Section 3: Initial Evaluation – including a description of the conceptual release models, exposure pathways, preliminary operable units, a preliminary exposure pathway assessment, a summary of potentially Applicable or Relevant and Appropriate Requirements (ARARs), and a preliminary assessment of potential impacts to human health.
- Section 4: Work Plan Rationale – including a description of the project data quality objectives, sampling approach, and technical approach.
- Section 5: Investigation Tasks – including a discussion of the components of the field investigation.

- Section 6: Reporting and Schedule – including a summary of the report contents, preliminary discussion of potential response actions, and the schedule for field work and reporting.
- Section 7: References Cited – including a list of documents referenced in this document.
- Tables- including a summary of data from past investigations and proposed sampling locations and parameters.
- Figures- including current site conditions, results from past investigations, and planned sampling locations.

1.2 SSI/RI and other UMA Investigations

A Phase I Environmental Site Assessment (Phase I) was prepared for UMore Park in 2006 (Peer, 2006). Barr updated the Phase I components that relate to the UMA in 2008. In the updated Phase I, seven SOC's that had a potential for release or threatened release of petroleum products or hazardous substances were identified in the UMA. Based on comments from Dakota County, an eighth SOC (Undetermined Use Area) was considered for investigation.

Barr submitted a draft work plan to the MPCA describing the proposed investigation of the eight SOC's in the UMA (Barr, 2008b). Based on comments from the MPCA, SOC's 1-3 and 6-8 were separated from SOC's 4 and 5 and became the subject of a separate investigation to determine if a release of a hazardous substance or petroleum products has occurred within the SOC's 1-3 and 6-8. The Phase II Investigation Work Plan for SOC's 1-3 and 6-8 has been submitted to the MPCA under separate cover (Barr, 2009a). SOC's 4 and 5 are being investigated in accordance with this Work Plan because previous investigations have either identified releases from GOW and post-GOW (SOC 5) site-use activities or lacked sufficient data to adequately assess the presence or absence of a release (SOC 4).

1.3 Project Roles

The University is the property owner and has the authority to commit the resources necessary to meet project objectives and requirements. The University of Minnesota Technical Project Manager is Janet Dalglish who will be responsible for reviewing all project deliverables and documents. She has overall authority and responsibility for technical aspects of the project. The University's co-Project Manager is Steven Lott, who is responsible for administrative considerations, budget and coordination with UMore Park staff and resources.

Barr is the consultant to the University and is charged with assisting with the environmental aspects of the Project. The Barr project manager, Jim Aiken, is responsible for preparing work plans and scoping documents; coordination, scheduling, and oversight of project activities with project team members; and communicating with the client and subcontractors.

This SSI/RI Work Plan has been developed to be consistent with CERCLA Guidance (EPA, 1988) and will be administered under the authority of the MPCA Superfund Program. The MPCA project manager, Gary Krueger and Project Hydrogeologist, Dave Scheer, have overall responsibility for providing regulatory oversight and evaluation of the investigation and development of appropriate response actions. William Scruton is the Quality Assurance Coordinator responsible for review of the analytical methods and the analytical reports.

The investigation described in this Work Plan will be performed in accordance with the Quality Assurance Project Plan (QAPP). A Field Sampling Plan (FSP) and the QAPP will be submitted to the MPCA under separate cover as Parts 1 and 2, respectively, of the Sampling and Analysis Plan (SAP) for SOC 4 and 5.

2.0 Site Background and Physical Setting

2.1 Location & Current Conditions

The UMA is located approximately 15 miles southeast of the Twin Cities, just west of US Highway 52 and south of Dakota County Road 42, between the Mississippi River and the Vermillion River. The boundary of the UMA was modified in May 2009 and now consists of 1,607 acres within a predominantly rural area located generally between Biscayne and Akron Avenues. The UMA occupies Section 4 and part of Section 3 in T 114N, R 19W and portions of Sections 28 and 33 of T115N, R19W in Dakota County (Figure 1).

SOCs 4 and 5 are located in the eastern central portion of the UMA within Sections 3 and 4 of T114N, R19W (Figure 2). The two SOC's are bounded to the north by Dakota County Road 46 (a.k.a, 160th Street West) and surrounded by agricultural fields to the west, south, and east. The southern reach of SOC 4 abuts to the drainage ditch on the east side of Station Trail (formerly known as West Patrol Road).

SOC 5 is currently referred to as the Central Services Station and is used for service and maintenance activities to support the University's Agricultural Experiment Station (AES). Operations include equipment repair and maintenance, storage and distribution of supplies, coordination of research and farm operations, feed mixing, and grain drying and storage. Eight GOW-era DNT-storage bunker buildings (260-A through 260-H), which are identified by the University as Buildings 601 through 608, are present in SOC 5. The north, east, and southern sides of storage bunkers 260-E through 260-H (Buildings 605 through 608) are currently surrounded by soil berms, hence the term "bunker" has been used to historically describe these buildings as has the term "DNT Igloos." The bermed soil around former DNT-storage bunkers 260-A through 260-D (Buildings 601 through 604) has been removed. The roofs of Buildings 603 and 604 have been removed to accommodate storage of miscellaneous supplies (wood, metal, farm equipment).

SOC 4 consists of a drainage swale that connects Dakota County Road 46 and Station Trail south of SOC 5. The portion nearest County Road 46 had a DNT loading platform (Building 263-C on Figure 2) along a railroad line that was demolished after GOW operations ceased. The southern 700 feet of the drainage swale, referred to as the "lower reach," is wooded. The remainder of the drainage swale is a farm field planted with row crops.

2.2 Physical Setting

The physical setting of the UMA and SOC 4 and 5 in terms of climate and hydrology, soils, surface water geology, and hydrogeology is described in the following subsections.

2.2.1 Climate and Hydrology

The average daily maximum temperatures range from 23 to 83 degrees Fahrenheit and the average annual precipitation is approximately 32.5 inches (NOAA, 2008). Average annual recharge ranges from about 6 to 10 inches per year over the UMA (Metropolitan Council, 2009). The UMA is located on a topographically high area, with the ground surface sloping gently towards the northeast in the northern two-thirds and to the southeast in the southern one-third of the UMA. The ground surface elevation at the UMA varies from approximately 950 to 940 feet above mean sea level (MSL). The ground surface elevation in SOC 4 and 5 is approximately 940 ± 5 feet MSL. Existing conditions and surface topography within SOC 4 and 5 are shown on Figure 2.

2.2.2 Soils

Waukegan series soils cover much of the UMA and SOC 4 and 5 (Figure 3; USDA, 2008). The Waukegan series consist of deep, well drained soils that form on outwash plains and stream terraces. These soils are described as moderately to rapidly permeable and have the ability to readily absorb water.

Kennebec silt loam series soils, which consist of moderately well drained soils formed in alluvium, are mapped in small depressions located in SOC 4 (Figure 3).

2.2.3 Surface Water

No surface water bodies exist in the UMA or SOC 4 and 5 (Figure 4). A swale that is mapped as an intermittent stream passes through SOC 5 and the lower reach of SOC 4 (DNR, 2009). University personnel report that surface water flow does not occur through SOC 4 and 5 with the exception of runoff during major storm events (1-inch or more precipitation) or spring snow melt.

2.2.4 Geology

2.2.4.1 Unconsolidated Deposits

The surficial soils are relatively thin across the UMA (generally less than 5-feet thick) and are derived from loess (wind blown silt) or consist of localized fill associated with various land use activities on the property. The underlying glacial deposits consist primarily of outwash comprised of sand and gravel. The thickness of the outwash is anticipated to vary from 65 feet in the northern

portion of SOC 5 to 90+ feet in the lower reach of SOC 4. Till was encountered approximately 20 feet below the ground surface in the northern portion of SOC 4, however, it is expected that the till is underlain by outwash.

The till, described as a gray, massive (unlayered) diamicton with a homogenously mixed texture consisting of gravel and sand within a clay matrix, is present beneath the outwash in the vicinity of SOC 4 and 5. The till thickness is estimated to range from 35 feet in the southern portion of SOC 5 to over 100 feet in the northern portion of SOC 5. The till is underlain by a lower outwash unit that is approximately 10 feet thick (Barr, 2009).

2.2.4.2 Bedrock

The uppermost bedrock unit beneath SOC 4 and 5 is the Prairie Du Chien Group (Barr, 2009b). The Prairie Du Chien Group and the underlying Jordan Formation Sandstone together comprise the primary aquifer that is used locally for domestic water supply and crop irrigation. The St. Lawrence Formation, considered an aquitard (or confining unit), is present below the Jordan Sandstone. A generalized stratigraphic column is shown in Figure 5.

2.2.5 Hydrogeology

Regional groundwater flow within the outwash and underlying aquifers is to the northeast towards the Mississippi River (Figure 6; Barr, 2009b).

Groundwater is expected to be present at about elevation 885 feet MSL (or 55 feet below the ground surface) in the vicinity of SOC 4 and 5. The water table surface is anticipated to be within the outwash in the southern portions of SOC 4 and 5 and may be within the till in the northern portion of SOC 4. As reported during the FSI (Bay West, 2009), perched water may be present above the till in the northern portions of SOC 4 and 5.

2.3 Operational History

2.3.1 SOC 4

According to research conducted by Dakota County, a DNT loading platform (263-C on Figure 2) received drums of DNT by rail. The DNT drums were then reportedly trucked to the DNT storage bunkers (Buildings 601-608 on Figure 2) (Appendix A). There are no records indicating whether releases of the DNT occurred at the platform. A drainage ditch is faintly visible on aerial photographs extending south of the platform and then turning southwest. A topographic low area is present about 750 feet south of the platform where it joined drainage from the east. The drainage

ditch receives surface water runoff from SOC 5 that enters a shallow depression that appears to be a former settling basin directly south of SOC 5 (Figure 2). The drainage ditch continues to the southwest until it joins the eastern ditch along Station Trail. Some concrete rubble is visible in the lower reach of the ditch, suggesting that portions of the ditch may also have been filled with demolition debris.

The lower reach of drainage ditch, from the apparent former settling basin south of SOC 5 to Station Trail, is identified by the Army as AOC 3 DA-1 (Area of Concern 3, Drainage Area 1; Bay West, 2009). The FSI did not include an investigation of the loading platform or the portion of the drainage ditch north/northeast of the former settling basin.

2.3.2 SOC 5

Research by Dakota County, aerial photography, and the Army's PA and SI indicate that eight DNT-storage bunkers were constructed to store DNT for GOW operations (Bay West, 2009). The DNT storage bunkers are identified as University Buildings 601-608 and GOW Buildings 260-a through 260-h on Figure 2. Once SOC 5 was deeded to the University, the DNT storage bunkers were used as AES storage facilities and to support agricultural site operations.

SOC 5 is identified by the Army as AOC 5 (Bay West, 2009). Historical operations within SOC 5 are described in the following sub-sections.

2.3.2.1 DNT Storage Bunkers

Each DNT storage bunker was constructed with a peaked floor slab to direct drainage to gutters along the north and south interior building walls. A central drain was also reported to be present near the center of the floor slabs (Bay West, 2009). The gutters were sloped to dry well-type sumps located below ground at the northwest and southwest corners of each bunker. GOW-era documents (USACE, 2006) indicate that the sumps extended approximately three feet into the ground and were filled with gravel to accommodate infiltration (Appendix A).

The results of a 1947 inspection of GOW areas are summarized in the Jefferds memo (Appendix A). The memo references observed DNT or smokeless gun powder in the central drains of DNT storage bunkers 260-A, E, and F (Figure 2).

Since taking title to the site, the University has used the bunkers for the storage of equipment, pesticides, and fuel.

2.3.2.2 University Use

The University's operations within SOC 5 have included equipment fueling areas west of Buildings 602 and 611 and pesticide mixing and equipment washing near Building 621.

In 1990, a leaking underground storage tank (UST) was identified on the west side of Building 602 and 611 (Appendix A) (Peer, 2006). The UST had a capacity of 500-gallons and was used to store leaded gasoline for vehicle and equipment fueling. Additional fuel tanks were located west of Building 602 (unleaded gasoline) and southwest of Building 611 (diesel). All of the USTs have been removed.

Pesticide mixing and equipment rinsing were conducted south of Building 621 in SOC 5. Rinsate containing residual pesticides was collected in a cistern and directed to a lagoon located approximately 75 feet south of Building 621. The lagoon was unlined to allow for the infiltration of the rinsate water (Appendix A).

2.4 Previous Investigations

Many of the previous investigations regarding UMore Park have focused on areas east of the UMA. This section describes the previous investigations as they apply specifically to the SOC 4 and 5.

2.4.1 Petroleum Release in SOC 5

Closed leak site #2529 is located on the west side of Buildings 602 and 611 (Figure 7) (Appendix A). Soil vapor headspace readings from soil samples collected from a series of soil borings advanced around the former UST indicated the presence of petroleum in the subsurface soils. Headspace readings of up to 400 parts per million (ppm) were measured in soil at a depth of 21 feet below the ground surface (bgs). Groundwater samples collected from three monitoring wells in the area were analyzed for volatile organic compounds (VOCs), gasoline range organics, and lead (dissolved). None of the analytical parameters were detected at or above the method detection limits in any of the monitoring wells (Peer, 1994). . A vapor extraction system was installed at the leak site and operated until site closure was granted by MPCA. Excerpts of investigation reports (STS, 1991; Peer, 1994) are summarized in Appendix A. Based on these results, it assumed that low concentrations of petroleum remain in the soils west of Buildings 602 and 611.

2.4.2 Pesticide Release in SOC 5

A series of soil borings and monitoring wells were installed to delineate the extent and magnitude of pesticide impacts from a lagoon used to dispose of pesticide rinsate water south of Building 621

(Figure 7; Appendix A). Soil sampling results indicated that detectable concentrations of Minnesota Department of Agriculture (MDA) List 1 pesticides were generally limited to the area of the former lagoon. The cistern and the pesticide impacted soils from the lagoon were removed and managed off-site with MDA approval (Peer, 2001; Girtz, pers. comm., 2008). The analysis of soil samples collected at the base of the excavation indicated that the soils left in place contained no detectable alachlor or trifluralin at a detection limit of 0.5 mg/kg.

Groundwater results collected in 2001 from locations east (downgradient) of the lagoon showed low concentrations of atrazine, metolachlor, and cyanazine. . Based on these investigation results, it is assumed low levels of pesticides remain in the groundwater down gradient of the former pesticide rinsate located south of Building 621.

2.4.3 Phase I Environmental Site Assessment – UMore Park

The Phase I (Peer, 2006) was conducted on the entire UMore Park in accordance with ASTM E 1527-05 and provided numerous findings regarding of the UMA and information on several Recognized Environmental Conditions (RECs). A REC means that an existing release, a past release, or a material threat of a release of hazardous substances or petroleum products into the ground, groundwater, or surface water on the property has been identified and would be of concern from a regulatory perspective.

The Phase I concluded that the closed petroleum or agricultural releases present in SOC 5 (discussed above) constitute historical RECs. Peer recommended additional review of these release sites to assess the need for further investigation or cleanup. Appendix A contains Phase I excerpts relating to SOC 5. No RECs were identified in SOC 4.

2.4.4 USACE Investigations of the Former GOW

USACE has conducted a PA (USACE, 2006) and FSI (Bay West, 2009) over a portion of the former GOW. The former DNT storage bunkers (AOC 5) and the adjacent drainage area (AOC 3 DA-1) were identified as potential concerns in the PA and carried forward to the FSI.

2.4.4.1 SOC 4 (AOC 3 DA-1)

Investigation of AOC 3 DA-1 included collection of four soil samples from two sampling locations and one groundwater sample. No sampling was conducted near the DNT loading platform or the drainage ditch leading to AOC 3 DA-1 from the loading platform. The soil and groundwater samples collected from AOC 3 DA-1 were analyzed for 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-

DNT), DPA, and nitrocellulose. All samples were non-detect for all analytes except nitrocellulose in soil samples. Nitrocellulose was detected in three of the four soil samples. However, there are no Soil Reference Values (SRVs) for nitrocellulose. Detected results are shown on Figure 7 and in Table 1.

2.4.4.2 SOC 5 (AOC 5)

Investigation of the former DNT storage bunkers during the FSI included the placement of twelve soil borings and the collection of 12 surface soil samples, 24 subsurface soil samples and one groundwater sample. FSI sampling locations are shown on Figure 7. The soil samples were analyzed for one or more of the following analytes: pesticides, diesel range organics (DRO), gasoline range organics (GRO), 2,4-DNT, 2,6-DNT, metals, polyaromatic hydrocarbons (PAHs), DPA, and nitrocellulose. The groundwater sample was analyzed for one or more of the following analytes: DRO, GRO, 2,4-DNT, 2,6-DNT, metals, PAHs, and DPA.

The analytical results from the FSI are presented on Figure 7 and are summarized (relative to SRVs,) in Table 1. Notable detections include:

- Dieldrin was detected at a concentration of 17 milligrams per kilogram (mg/kg) in surface soil sample AOC5-GP1-0-6 inches near Building 608. The Tier I SRV for dieldrin is 0.8 mg/kg.
- Lead was detected at a concentration of 330 mg/kg in surface soil sample AOC5-GP9-0-0.5 feet near Building 602. The Tier I SRV for lead is 300 mg/kg.
- Mercury was detected at a concentration of 0.55 mg/kg in surface soil sample AOC5-GP1-0-0.5 feet in SOC 5. The Tier 1 SRV for mercury is 0.5 mg/kg.
- PAHs, reported by benzo-a-pyrene (BaP) equivalent, was detected above the Tier 1 SRV of 2 mg/kg in surface soil samples collected from 0 to 0.5-feet at locations AOC5-GP4, AOC5-GP8, AOC5-GP10, and AOC5-GP11.
- 2,4-DNT was detected at a concentration of 0.35 mg/kg at AOC5-GP9-0-0.5feet. The Tier I SRV and SLV are 50 and 0.001 mg/kg, respectively.

2.4.5 Additional Historical Information Review and Site Reconnaissance

Barr Engineering conducted additional historical information review to supplement the Phase I and other previous studies and to help focus efforts to investigate areas of the UMA that have the

potential for release or threatened release of petroleum products or hazardous substances. The scope included reviewing the following historical information for the UMA:

- An updated GIS database of possible environmentally impacted areas from Dakota County (Dakota Co., 2008).
- Updated database search of government records (EDR, 2008) consistent with ASTM E 1527-05 and EPA's All Appropriate Inquiry Rule.
- Review of historical city directories, Sanborn insurance maps, and historical aerial photographs.
- Review of University records and reports regarding general site setting information and past releases. This information included a 1949 topographic survey, facility diagrams, a directory of University buildings compiled in the early 1990s with oblique aerial photographs, and reports on past leaking underground storage tank investigations and agricultural chemical spills that were cleaned up and administratively closed.
- Review of the Phase I (Peer, 2006) and evaluation of the historical RECs and tenants that were identified in that report. None of the University tenants appear to be associated with SOC 4 or SOC 5.
- Site reconnaissance of buildings and areas identified in the above resources that have or may potentially be associated with releases of hazardous substances or petroleum products in SOC 4 and SOC 5. The site reconnaissance included discussions with University staff familiar with past operations within the UMA.

2.4.5.1 Evaluation of Sites of Concern

Barr collected information from multiple data sources to identify RECs within the UMA that were then evaluated as SOC. Observations from a site visit are summarized in Appendix B. Based on the above information, Barr considered whether an identified site met the ASTM 1527-05 definition of a REC and would therefore require additional investigation. SOC 4 and 5 were carried forward for investigation based on the following findings:

- SOC 4 -- based on the potential for impacts from surface water run-off from the former DNT loading Platform and SOC 5, the concrete rubble observed near Station Trail, and the detection of nitrocellulose in soils samples collected during the FSI.
- SOC 5 -- based on the presence of PAHs above the Tier I SRV, the presence of DNT above Tier 1 SLV, the presence of lead and mercury above the Tier I SRVs, the detection of nitrocellulose in soils, past operations associated with the DNT storage bunkers and possible spills into floor drain and dry wells, visible flaking of tar coating from the exterior walls of

the DNT storage bunkers on to the surrounding ground surface, and post-GOW pesticide and petroleum releases on the east and west sides of the northern third of AOC 5.

2.4.5.2 Historical RECs Listed as Closed with No Evidence of Remaining Impacts

Post-GOW releases at the UMA appear to be related to petroleum and pesticide storage and management. All underground storage tanks (USTs) were removed from the Agricultural Experiment Station research areas in the UMA in the 1990s. Fueling for vehicles and equipment is now centralized within the Central Services area near the administration building using above ground storage tanks (ASTs).

Most of the documented past releases identified in the EDR Report (see Executive Summary in Appendix B) are listed as having been investigated, cleaned up, and closed by the MPCA or MDA. Based on the closure of the petroleum and pesticides sites, it appears that the historical petroleum and pesticide RECs have been adequately addressed, are not considered RECs, and will not require significant future investigation or corrective action.

2.4.6 Groundwater Assessment Work Plan for EIS

The University is currently preparing an EIS for gravel mining in the UMA. As part of the EIS, various investigations have been initiated including a Groundwater Assessment (Barr, 2009b). The purpose of the Groundwater Assessment is to broadly characterize groundwater conditions and provide information needed to construct a groundwater flow model for the UMA. The flow model will be used to evaluate potential environmental impacts and develop mitigation strategies, if necessary, related to the mining and reclamation.

The Groundwater Assessment included the use of new and existing wells to collect water level and other hydrogeologic data that will help define and calibrate the flow model. The flow model includes pumping data from all water supply wells that have existing appropriation permits. This includes wells that pump more than 10,000 gallons per day. All groundwater supply wells with appropriation permits within approximately five miles of SOC 4 and SOC 5 are incorporated into the model. These wells are completed in the bedrock units and, based on modeling results, are not generally susceptible to impact from releases at the UMA. The modeling results also indicate that the existing municipal supply wells and irrigation wells do not significantly influence groundwater flow directions.

Although the well locations for the Groundwater Assessment were not selected to address specific issues in SOC 4 and 5, groundwater samples from selected monitoring wells will be used to provide groundwater data in SOC 4 and 5. Additional monitoring wells may be added to the scope of

investigations if needed to define impacts from SOC's 4 or 5. Discussion of background groundwater sample locations is included in the work plan for SOC's 1-3 and 6-8 (Barr, 2009a).

3.0 Initial Evaluation

3.1 Conceptual Release Models, Operable Units, and Constituents of Concern

SOC 4 and SOC 5 have been previously investigated to varying levels. The only previous investigation of SOC 4 was the Army's FSI which included the collection of four soil samples and one groundwater sample in a small portion of the SOC 4 and the analysis of those samples for a few chemicals of potential concern. At SOC 5, several environmental investigations and corrective actions have occurred. These include investigation and operation of an SVE system to address a past petroleum release near Building 602 and 611 (260-F), investigation and soil excavation to address a past pesticide release near Building 608 (260-A), and the Army's investigation of potential releases in the vicinity of the former DNT storage bunkers.

Because of the varying levels of previous investigations at SOC 4 and 5, and the somewhat differing objectives of the investigation proposed in this Work Plan (i.e., release detection in SOC 4 and extent and magnitude investigation in SOC 5), discussion of conceptual release models and constituents of concern for SOC 4 and SOC 5 are organized by preliminary operable unit (OU) designations. The delineation of separate OUs has been based on a review of historical operations and past investigation results with consideration to the conceptual release models. The preliminary OU designations are not intended to indicate that the areas necessarily will be the subject of future remediation.

Description of the conceptual release models, preliminary OUs, and associated constituents of concern for SOC 4 and SOC 5 are presented below.

3.1.1 SOC 4 Conceptual Release Model and Operating Units

As described previously, past operations at SOC 4 included the unloading of drums of DNT (a dry crystalline product) at the former loading platform. The primary conceptual release model for SOC 4 consists of spills of dry DNT at the former loading platform, subsequent incorporation of spilled DNT into surface soils and the overland transport of DNT via water runoff. Based on a site reconnaissance, additional potential releases at SOC 4 include deposition of SOC 5 constituents of concern (COCs) via surface water runoff from SOC 5 onto SOC 4 and the placement of demolition debris from the demolition of GOW-era structures. Based on past operations and this conceptual

release model, SOC 4 has been divided into the following OUs for the purpose of delineating investigation areas:

- SOC 4-OU1: Former DNT Loading Platform and Drainage Ditch East of SOC 5 (AOC 3 DA-1)
- SOC 4-OU2: Settling Basing and Drainage Ditch South of SOC 5 (AOC 3 DA-1)
- SOC4-OU3: Area of Visible Debris Disposal

The following subsections describe the constituents of concern for each of the SOC 4 OUs. The boundaries of each OU are shown on Figure 8. The limits of the OUs overlap somewhat (such as OU2 and OU3).

3.1.1.1 OU1 - Former DNT Loading Platform and Drainage Ditch

Potential releases in SOC 4-OU1 include 2,4-DNT and/or 2,6-DNT (collectively referred to as DNT) that may have been spilled on surface soils and subsequently incorporated into shallow subsurface soils at the DNT loading platform. Residual DNT spilled at the platform also may have been transported down the drainage ditch with surface water runoff and accumulated in topographic lows south of the platform.

Based on past operations and potential releases, the COCs for SOC 4-OU1 are:

- 2,4-DNT and 2,6-DNT - DNT was unloaded from the former DNT loading platform. Although no releases were reported, a hypothetical release would consist of drums broken during handling releasing DNT to soils around the platform. Subsequent run off from the platform could have carried DNT to the lower reaches of the ditch.
- DPA, Di-n-butyl phthalate (DBP), and nitrocellulose – DPA and nitrocellulose are indicated to have been stored in the bunkers (Bay West, 2009) and may also have been unloaded at the DNT Loading Platform. DBP is associated with the previous GOW operations and is considered a COC. Potential releases of DPA, DBP, and nitrocellulose may have resulted in releases to soils around the platform. Subsequent run off from the platform may have carried DPA, DBP, and nitrocellulose to the lower reaches of the ditch.
- Perchlorate – a propellant not believed to be associated with GOW, but is present in soils or groundwater at other former munitions sites that were operated similar to GOW. At the

request of the MPCA, groundwater collected from the northern portion of SOC 4-OU1 (which is downgradient of SOC 5) will be analyzed for perchlorate.

3.1.1.2 OU2 – Settling Basin and Drainage Ditch South of SOC 5 (AOC 3 DA-1)

The area targeted for investigation in this OU is the settling basin south of SOC 5 due to likely increased deposition of sediment entrained in runoff from the former DNT Loading Platform and SOC 5.

Potential releases in SOC 4-OU2 include all mobile COCs from SOC 4-OU1 and SOC 5 (discussed later in this report) that were subject to overland transport via runoff. Based on past operations and potential releases, the COCs for SOC 4-OU2:

- 2,4-DNT and 2,6-DNT - DNT was unloaded from the former DNT Loading Platform. Although no releases were reported, drums broken during handling could have released DNT to soils around the platform. Subsequent run off from the platform may have carried DNT to SOC 4-OU2.
- DPA, Di-n-butyl phthalate (DBP), and nitrocellulose – DPA and nitrocellulose are indicated to have been stored in the DNT storage bunkers (Bay West, 2009) and may also have been unloaded at the DNT Loading Platform. DBP is associated with the previous GOW operations and is considered a COC. Potential releases of DPA, DBP, and nitrocellulose may have resulted in releases to soils around the platform. Subsequent run off from the platform could have carried DPA, DBP, and nitrocellulose to SOC 4-OU2.
- VOCs, Pesticides, and PCBs – these compounds are included as COCs in SOC 4-OU2 due to their potential presence in SOC 5. Investigation of VOCs, pesticides, and PCBs in SOC 4-OU2 will target the sedimentation basin immediately south of SOC 5.

3.1.1.3 OU3 – Surficial Debris Area

During site reconnaissance, an area of surface debris was observed in SOC 4-OU3. OU3 is also subject to COC transport from SOC 4-OU1 and SOC 4-OU2, however, it is assumed that much of the COCs would settle out in the sedimentation basin in SOC 4-OU2 before reaching this OU. Based on this assumption, sampling and analysis of COCs from SOC 4-OU1 and OU2 in SOC 4-OU3 will be limited.

Based on past operations and potential releases, the constituents of concern (COCs) for SOC 4-OU3 are:

- Metals – leaching of debris and ash may have resulted in the release of metals.
- Asbestos – commonly found in GOW-era buried debris and construction materials. Any suspected PACM encountered in SOC 4 will be tested for asbestos.

3.1.2 SOC 5 Conceptual Release Model and Operating Units

Past operations that potentially resulted in a release of hazardous substances or petroleum products to soil or groundwater at SOC 5 include the use of the DNT Storage Bunkers, pesticide handling, and petroleum fueling. Based on a review of construction plans, past investigation and corrective action reports, and the site reconnaissance, the conceptual release model consists of spills to the ground surface, releases from USTs to shallow subsurface soils (generally less than 10 feet) and infiltration of potentially impacted water. Spills to the ground surface are anticipated to have infiltrated into near surface soils or have become incorporated into surface soil and have been subject to overland transport with runoff. As a result of the permeable nature of surface and subsurface soils, a release to shallow subsurface soils would be expected to migrate downward from the source and migrate laterally with groundwater flow within the outwash aquifer if sufficient mass is released. The released COCs would be subject to attenuation processes in the unsaturated zone and in the groundwater system.

Based on historical operations and the conceptual release model presented above, SOC 5 has been divided into the following OUs for the purpose of the investigation:

- SOC 5-OU1 a-h – DNT Storage Bunkers (Buildings 260-A through 260-H)
- SOC 5-OU2 – Pesticide Release Area
- SOC 5-OU3 – Petroleum Release Area

The following subsections describe the constituents of concern for each of the OUs in SOC 5. The boundaries of each OU are shown on Figure 10. The limits of the OUs partially overlap (e.g., OU1a and OU2, OU1f and OU3).

3.1.2.1 OU1 – DNT Storage Bunkers (Buildings 260a through 260h)

The DNT Storage Bunkers have been used to store explosives (including DNT and nitrocellulose), pesticides, petroleum products, farm equipment, and general supplies. Releases of the stored materials may have occurred via infiltration into shallow soils from the floor drains, gutters, and/or dry wells located in the northwest and southwest corners of the structures. In addition to potential releases of materials stored in the DNT Storage Bunkers, the exterior walls of some (if not all) of the bunkers appear to have been coated with a heavy tar-like substance. Due to weathering processes, the tar material is flaking off portions of the exterior walls and has been incorporated into surface soils around some of the bunkers.

Based on past operations and suspected releases, the COCs for SOC 5-OU1 are:

- DNT, DPA, DBP, Nitrocellulose – DNT has been previously detected in soil samples from this area. DNT, DPA, and nitrocellulose may have been stored in some of the buildings.
- Metals – potentially present in pesticides and herbicides.
- Pesticides – used for plant suppression during GOW-era activities and stored in some of the bunkers.
- Semi-volatile organic compounds (SVOCs) –present in tar coatings on exterior building walls and contained in soil removed from sides of walls. PAHs have been detected in soil sampling and in low concentrations in groundwater samples from this area.
- VOCs – present in petroleum cleaning solvents and fumigants that may have been stored in the buildings or used to clean equipment.
- Perchlorate – a propellant not believed to be associated with GOW, but is present at other former munitions sites. At the request of the MPCA, groundwater collected from the northern portion of SOC 4-OU1 (which is downgradient of SOC 5) will be analyzed for perchlorate.

3.1.2.2 OU2 – Pesticide Release Area

Dieldrin was detected above its Tier I SRV in a surface soil sample collected near Building 608 during the FSI. The suspected source of the dieldrin is a surface release of pesticides from pesticide use, storage, or equipment washing near Building 608 (260-A).

Additional investigation will be conducted on the edges of the former lagoon soil excavation south of Building 621 based on discussions with University staff (Girtz, pers. comm., 2008) which indicated that it is possible that releases from a former cistern and lagoon used to contain and infiltrate pesticide wash water may have resulted in soil and groundwater impacts that still remain in this area.

Potential COCs associated with SOC 5-OU2 are:

- Pesticides – used to suppress plant growth during GOW-era activities, stored in some of the bunkers, and handled as part of AES operations.

The potential affected media, routes of migration, and exposure risks for the COCs associated with the pesticide release are described in Table 2.

3.1.2.3 OU3 – Petroleum Release Area

One closed UST site (LEAK #2529; Peer 1994) is located in the northern portion of SOC 5. The leak site was investigated and closed.

Potential COCs associated at SOC 5-OU3 are:

- Metals – potentially present in leaded fuels.
- VOCs – may be present as the result of past fuel spills, storage of chemicals, and as solvents that may have been used to clean equipment.

3.1.2.4 Other SOC 5 Sampling

Surface soils in green space and road ways within SOC 5 will be sampled and analyzed for selected COCs as described below:

- Green space areas - eleven surface soil samples will be collected and analyzed for pesticides, SVOCs, and metals to evaluate COC concentrations in areas away from specific OUs. Data will be used to evaluate general surface soil quality
- Roadways – samples of road base materials will be collected and analyzed for PCBs to determine if PCB-containing oils were used for dust control within SOC 5.

Groundwater in bedrock aquifers at and downgradient of SOC 5 will be sampled and analyzed for selected COCs as described below:

- Water supply wells – groundwater samples from SOC 5 and nearby residences down gradient of SOC 5 will be sampled to evaluate water quality. COCs will be VOCs, SVOCs, metals, pesticides, and perchlorate.

3.2 Preliminary Exposure Pathway Assessment

The primary exposure pathways for the COCs identified above are inhalation, ingestion, and dermal contact. Groundwater consumption is also considered, however, groundwater in the outwash is not used for potable water supplies. The potentially affected media, routes of migration, and potential exposure pathways for each COC are shown in Table 2.

3.3 Potentially Applicable or Relevant and Appropriate Requirements and to-be-Considered Criteria

The National Contingency Plan (NCP) (40 CFR 300.430(e)(9)(iii)(B)) requires that remedial action alternatives be assessed to evaluate whether they attain applicable or relevant and appropriate requirements (ARARs) under federal and state environmental laws or facility siting laws, or provide grounds for invoking one of the waivers under paragraph (f)(1)(ii)(C) of this section. In addition to ARARs, the identification and evaluation of remedial action alternatives may consider, as appropriate, other advisories, criteria, or guidelines, collectively called to-be-considered criteria (TBCs).

It is anticipated that the ARARs and TBCs listed in Table 3 will be considered to evaluate site characterization data and guide the initial review of remediation activities.

3.4 Preliminary Assessment of Risk to Human Health

A preliminary assessment of risk to human health can be made by comparing soil and groundwater results from the FSI in SOC 5 to risk based health standards such as MPCA SRVs for a residential setting or Health Risk Limits (HRLs) published by the Minnesota Department of Health (MDH)

Previously collected soil sampling data for SOC 5 are summarized on Figure 7 and Table 1. Table 1 summarizes the FSI sample locations, depths, analytes, and concentrations that exceed the Tier I SRVs or do not have established SRVs. Data collected during the investigation of the pesticide and petroleum releases are not included in Table 1. Pre-corrective actions (such as soil removal or operation of a soil venting system) are not included in Table 1. Headspace and groundwater samples prior to implementation of corrective action are shown on Figure 7. Of the samples previously collected in SOC 4 and SOC 5, the following COCs were detected above a risk based health criteria:

SOC5-GP1	0-5'	Dieldrin, mercury
SOC5-GP4	0-5'	BaP
SOC5-GP8	0-5'	BaP, mercury
SOC5-GP9	0-5'	DNT, lead
SOC5-GP10	0-5'	BaP
SOC5-GP11	0-5'	BaP

Data from SOC 4 is not included in this preliminary assessment because nitrocellulose was the only compound detected in SOC 4. An SRV has not been established for nitrocellulose.

4.0 Work Plan Rationale

4.1 Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the field and analytical data needed to support decisions made regarding investigative activities. DQOs help to ensure that the data collected are of an adequate level of quality for their intended uses.

The SSI/RI results will be used to: (1) determine the target analytes present in groundwater and soil; and (2) determine if concentrations represent a significant health risk. Data quality objectives are presented below along with brief descriptions of steps that will be taken to address the two objectives referenced above. The data must satisfy the site data quality objectives presented below.

1. Analytical results must accurately represent groundwater and soil quality: Chemical analyses will be performed to confirm the target analytes present and their concentrations at each SOC.
2. Analytical results must satisfy quality control requirements for accuracy, precision, representativeness, completeness and comparability (see Sampling and Analysis Plan).
3. Field data includes volatile organic headspace monitoring with a photo ionization detector (PID) (MPCA, 1998) and soil classification (ASTM D 2488). Field data requires an intermediate level of data quality compared to laboratory analyses that are completed in a controlled environment: Field data provide real-time data that may be necessary to make field decisions.
4. The laboratory analyses will require a high level of data quality and will be used to determine the type and concentrations of chemical constituents present at the property. These analyses are characterized by established QA/QC protocols and documentation and provide qualitative and quantitative data. These methods are based on EPA protocols. Analytical and data review procedures must be in accordance with recognized protocols to ensure that the data are valid.

Additional discussion of DQOs is provided in the QAPP.

4.2 Sampling Approach

Because the planned development will include the removal of surface soils to allow for sand and gravel mining, the surface and shallow subsurface soils will need to be managed on site (preferably in an unrestricted manner). To have maximum flexibility in managing these soils, a goal of this investigation is to identify areas in SOC 4 and 5 where there may be COC concentrations in soil that are above MPCA Tier 1 SRVs. These areas are most likely to occur where there has been a surface spill or a release to shallow subsurface soils. Accordingly, the sampling approach is designed to collect analytical data from surface and shallow subsurface soil based on the conceptual release model for each OU.

In areas with no evidence of a surface or shallow subsurface release, deep soil chemical profiling is unlikely to identify impacts. If results of the investigation indicate surface or near surface soils are impacted above SRVs, additional investigation will be conducted to evaluate deeper (potentially accessible) soils as appropriate.

4.2.1 General

4.2.1.1 Soil Sampling Locations

Specific sampling locations and sample collection depths will target locations and intervals that demonstrate indication of a release. At locations where the conceptual release model includes overland transport of COCs via runoff, sampling locations will be adjusted to ground surface depressions where runoff would be directed or expected to infiltrate. At suspected point source locations (such as dry wells), soil samples will be collected as close to the anticipated point of release as practical (i.e., base of the dry well). In all cases, intervals demonstrating an indication of a release of hazardous substances or petroleum products will be preferentially sampled with the purpose of characterizing the most impacted media encountered during the investigation. Figure 10 provides a general overview of the soil sampling strategy for various sampling techniques (described further in Section 5).

4.2.1.2 Soil Sampling Depths

The soil sampling strategy is designed to identify the magnitude and extent of hazardous substance or petroleum releases through the collection of discrete (grab) soil samples from direct push borings, test trenches, and groundwater samples from direct push borings. Grab sampling will be used to collect surface soil samples and composite sampling in accordance with Minnesota Department Agriculture (MDA) guidance will be used to delineate the extent of a suspected pesticide release near Building 608.

4.2.1.3 Subsurface Structures

Where subsurface structures (such as dry wells in SOC 5-OU1) are present, test trenching will be used to determine the presence of such structures and the nature and approximate extent of impacted soils. If demolition debris is encountered, soils directly under the debris will be sampled rather than the demolition debris material. Demolition debris characterization will consist of photographs and a detailed description of the types and nature of the materials encountered unless chemical impacts are suspected through observation and field screening or unless potential asbestos containing material (PACM) is encountered. Management of PACM and sampling of asbestos will be conducted in accordance with the revised Asbestos Emission Control Plan which will be submitted under separate cover.

4.2.1.4 Groundwater

Groundwater samples will be collected during this investigation to broaden investigation coverage and identify release areas that may be missed by surface sampling. If release areas are identified by soil or groundwater sampling, additional investigation may be necessary to identify the source and define the extent and magnitude of the release. Recommendations for additional sampling will be addressed in the report summarized the result of this investigation.

4.2.2 Operable Units

The sampling approach for each of the SOC 4 and SOC 5 OUs is discussed in the following subsections. Details of the sampling approach are provided in Section 5 and field methods are detailed in the SAP.

4.2.2.1 SOC-4 – OU1 – Former DNT Loading Platform and Drainage Ditch

The release model for OU1 involves surface spills and overland transport/sedimentation. There is also the possibility of shallow subsurface releases related to the presence and/or demolition of the former DNT Loading Platform. The sampling approaches that will be used in this OU are:

- Test trenching – soil excavation in the vicinity of the former loading platform and drainage ditch will be used to evaluate shallow subsurface and potentially accessible soils.
- Direct push soil borings –soil collection to evaluate surface, shallow subsurface, and potentially accessible soils and to collect a groundwater sample near the former DNT Platform.

4.2.2.2 SOC 4- OU2 – Settling Basin and Drainage Ditch South of SOC 5 (AOC 3 DA-1)

The release model for OU2 involves deposition of COCs from overland transport/sedimentation. The sampling approaches that will be used in this OU are:

- Test trenching – soil excavation in the settling basin and drainage ditch to evaluate shallow subsurface and potentially accessible soils.
- Direct push soil borings –soil collection to evaluate surface, shallow subsurface, and potentially accessible soils and to collect groundwater samples.

4.2.2.3 SOC 4- OU3 – Surficial Debris Area

The release model for this OU3 involves deposition of COCs from leaching from the placement of debris. The sampling approaches that will be used in this OU are:

- Test trenching – soil excavation in the drainage ditch to determine the presence and extent of debris and to evaluate underlying shallow subsurface and potentially accessible soils.

4.2.2.4 SOC 5- OU1 DNT Storage Bunkers (260a through 260h)

The release model for this OU1 involves releases from floor drains and dry wells and surface deposition of exterior wall coatings. The sampling approaches that will be used in this OU are (by conceptual release model):

4.2.2.4.1 Infiltration from Floor Drains and Dry Wells

- Test trenching – soil excavation in the vicinity of the dry wells and around the building walls to evaluate shallow subsurface soils and potentially accessible soils.
- Direct push soil borings – subsurface soil collection to evaluate shallow subsurface and potentially accessible soils and to collect a groundwater samples downgradient of OU1 buildings.

4.2.2.4.2 Exterior Wall Coating Deposition

- Direct push soil borings – subsurface soil collection to evaluate shallow subsurface soils.
- Surface soil sampling –surface soil sample collection to evaluate horizontal extent of tar coatings in soil.

4.2.2.5 SOC 5- OU2 Pesticide Release Area

The release model for this OU2 involves a surface release of pesticides near Building 608. Additional investigation will be conducted on the edges of the pesticide-impacted soil excavation south of Building 621. The sampling approaches that will be used in this OU are:

- Composite soil sampling in accordance with MDA guidance (MDA, 2005).
- Test trenching – soil excavations in the vicinity of the pesticide-impacted soil removal area south of Building 621 to evaluate underlying shallow subsurface and potentially accessible soils.
- Direct push soil borings – subsurface soil collection to evaluate shallow subsurface and potentially accessible soils and to collect a groundwater samples downgradient from OU2.

4.2.2.6 SOC 5- OU3 Petroleum Release Area

The release model for this OU3 involves a shallow subsurface release of petroleum near Building 602 and former petroleum USTs. The sampling approach that will be used in this OU is:

- Direct push soil borings – subsurface soil collection to evaluate surface, shallow subsurface and potentially accessible soils and to collect a groundwater samples downgradient from OU3.

4.2.2.7 SOC 5- Other Areas

The release model for these areas involves surface deposition of dust, blown soil/pesticides, or ash in green spaces, oil application for dust suppression on the dirt roads, and general groundwater contamination from past use of SOC 5. The sampling approaches that will be used in these areas are (by conceptual release model):

4.2.2.7.1 Surface Deposition

The surface deposition release model includes windblown deposition of pesticides or dust suppressant or ash fallout from burning. The sampling approach that will be used in this OU is:

- Surface soil sampling – sample collection to evaluate COC concentrations in surface soils.

4.2.2.7.2 Groundwater Impacts

The release model for groundwater impacts includes leaching and infiltration of hazardous substances to the water table. The sampling approach that will be used to assess groundwater is:

- Water supply well sampling – water supply wells at and downgradient of SOC 5 will be sampled for COCs to evaluate water quality in aquifers used in the area.

5.0 Investigation Tasks

This section provides an overview of the field methods that will be used during the investigation. A more detailed discussion of field methods and the Standard Operating Procedures is included in the SAP.

5.1 Sampling

5.1.1 Surface Soil Samples

The purpose of the surface soil sampling is to characterize soils at the surface in order to identify potential release areas. Surface soil samples will be collected with hand tools that will be decontaminated between samples. No VOC samples will be collected from surface soils unless there is obvious evidence of a release or unless indicated in Table 4. The surface sample locations in SOC 5 are shown on Figure 10.

5.1.2 Soil Borings

The purposes of the direct-push soil borings are:

- Allow the collection of soil samples to provide information on geology and hydrogeology including soil type, depth to water (at selected locations), and the presence of soil impacts.
- Allow collection of groundwater samples at the water table.

Soil borings will be advanced using direct-push methods to the target depths in Table 4. Soil samples will be collected continuously in 4 foot cores for geologic description and organic vapor screening with a PID. The soil type and textural classification will be recorded on boring logs using visual and manual methods described in ASTM D2488. The soil boring locations are shown on Figures 9 and 10.

Due to significant target depths and the nature of the native soils at the site, soil borings that extend greater than 20 feet below the ground surface may need to be advanced with a borehole casing.

Upon completion of soil sample collection and description, each soil boring will be sealed in accordance with Minn. Rules Chapter 4725.

5.1.3 Groundwater Sampling in Soil Borings

Groundwater samples will be collected from selected direct push borings as indicated in Table 4. The groundwater samples will be collected by driving a groundwater sampling probe approximately ten feet below the water table, retracting the drill stem to expose a stainless steel screen, and collecting a groundwater sample with a narrow-diameter, tubing/check-valve (Waterra) assembly as described in the SAP. In the event this groundwater sampling technique is not effective, a temporary PVC well screen and casing will be set to collect the sample. The groundwater probe or temporary well will be developed with the tubing/check-valve assembly for up to ten minutes to establish hydraulic communication with the aquifer and minimize sediment in the samples. The groundwater sampling locations are shown on Figures 9 and 10.

The direct-push borings may not be able to collect groundwater samples if the water table is below the bedrock surface or in the till. If this is the case, an alternate means of sampling may be proposed to the MPCA.

After the groundwater samples have been collected, the temporary wells will be removed and the borings will be sealed in accordance with the MDH Well Code.

5.1.4 Groundwater Sampling in Water Supply Wells

If access is obtained, groundwater samples will be collected from selected water supply wells at and downgradient from the SOC 5 as summarized in Table 4. The groundwater samples will be collected using water supply well sampling techniques in accordance with SOPs included in the SAP. The locations of the water supply wells that are planned for sampling are shown on Figure 11.

5.1.5 Test Trenching

Test trenches will be excavated by an experienced contractor using a track mounted excavator. Planned test trench lengths vary from 10 to 20 feet; actual trench lengths will be determined in the field with the objective of defining the approximate extent of the identified release and buried debris. Test trench may also be comprised of sequential and linearly spaced test pits labeled with letters (A, B, C, etc.).

The test trenches will extend vertically through any buried debris (or fill) and approximately two feet into the underlying native soil if the excavator reach is sufficient and the trench sidewalls can be safely maintained. If no fill or debris is encountered, the test trench depths will be at least four feet.

Each trench will be documented with a description of depth, length, soil encountered and samples collected.

Test trenching will be used near the DNT storage bunkers to identify the location of dry wells and assess soil quality below the features. The trenches will be placed adjacent to the building structure but will not extend more than 15 feet along the length of the foundations to maintain the structural integrity of the foundation. Test trench locations will be finalized in the field with consideration to subsurface utilities.

Test trenches will be sampled from the backhoe bucket. In general, one sample will be collected from selected test trenches as indicated in Table 4. The test trench locations are shown on Figures 9 and 10.

5.1.6 Composite Sampling for Pesticides

Composite soil sampling will be used to investigate the presence and magnitude of dieldrin and other pesticides near Building 608 in SOC 5. The composite soil samples will be collected using methods consistent with the soil sampling approach described in MDA Guidance Document 11, *Soil Sampling Guidance (11/05)* as discussed below.

Each composite soil sample will be comprised of sub-samples collected from four separate soil borings – one center boring and three perimeter borings. The center boring will be advanced at the identified composite soil sampling location. Three 5-foot deep perimeter borings will be advanced at distances of 7.5 feet from the center boring. The perimeter borings will be located equidistant from one another and form a 15 foot diameter circle around the center boring.

At each composite soil sample location, the center boring will be advanced to a minimum depth of ten feet to subsurface soils at the sampling location. The soil core from the center boring will be screened for organic vapors and soils will be classified using visual and manual methods in ASTM D 2488. Soil sub-samples will be collected from the intervals of 0 to 0.5 feet and 2 to 2.5-feet from the center boring for composite sampling purposes. The 0.5-foot and 2.5-foot sub-samples will be placed in separate clean containers and set aside for compositing with the sub-samples from the perimeter borings. In addition to these sub-samples, discrete sample will be collected from the 4.5 to 5-foot interval. The discrete sample from the 4.5 to 5-foot interval will be frozen and held for future analytical consideration. If the ground surface is covered by gravel or asphalt, the sampling intervals

will be adjusted so that the uppermost sample is collected beneath the ground surface cover and base material.

After the center boring has been completed, the perimeter borings will be advanced and soil sub-samples will be collected for composite sampling purposes. Sub-samples will be collected from the 0 to 0.5-foot and 2 to 2.5-foot sampling intervals in each of the perimeter borings. The sub-samples will be placed in a stainless steel mixing bowl with the center boring sub-samples of the same intervals and mixed thoroughly with single-use disposable mixing equipment. The composite soil samples will be collected by placing the mixed soil into sample containers provided by the laboratory and the containers will be placed in an iced sample cooler. Alternatively, stainless steel mixing equipment may be used with adherence to MDA approved decontamination procedures (MDA, 2005).

The 2 to 2.5-foot composite sample will be analyzed for the analytes listed in Table 4. The 0 to 0.5-foot composite sample and the 4.5 to 5 foot discrete sample will be kept frozen at the laboratory for consideration of future analysis. Locations of the composite pesticide soil samples are shown on Figure 10.

Any non-disposable sampling equipment used for composite pesticide sample collection will be decontaminated prior to and between soil sample collection locations and composite sampling events. Decontamination procedures will involve washing with a water/laboratory grade detergent solution, triple rinsing with distilled water, and a final rise with methanol.

5.2 Non-Sampling Investigation Tasks

5.2.1 Surveying

Surveying at the site will survey sample locations with sufficient accuracy to:

- Ensure that the sampling program provides adequate coverage of impacted areas and that the coverage can be accurately represented on maps of sufficient scale to illustrate the sample locations.
- Relocate the sample location with reasonable precision so that field staff are able to locate additional sample locations or duplicate the initial samples if needed.

Surveying will be conducted with a Global Positions System (GPS) receiver. If needed, alternate methods involving Total Station or optical surveying methods will be used. Data will be reported in accordance with MPCA guidance (2008). Details of the survey methods are provided in the SAP.

5.2.2 Well Survey

The Minnesota County Well Index (MGS, 2006) database will be used to identify all wells within a 4-mile radius of the UMA. The Department of Natural Resources (DNR) database of groundwater appropriations information will also be used to supplement the well survey. A door-to-door survey will not be conducted to verify well survey results.

6.0 Reporting and Schedule

6.1 Supplemental Site Inspection and Remedial Investigation Report

Data collected during the investigation will be tabulated and mapped for presentation in the SSI/RI Report. The report format will summarize and interpret the findings of the investigation and provide recommendations for follow-up investigation activities as necessary. It is anticipated that the locations of potential environmental impacts in SOC 4 and 5 will be illustrated with sample location maps and a tabular summary of sampling results.

ARARs and TBCs will be discussed but it is anticipated that soil data will be compared to the MPCA SRVs (Tier I and Tier II), considering the human-soil pathway for residential and industrial chronic risk scenarios (MPCA, 2005). A risk evaluation will include appropriate pathways of exposure and potential receptors. Because there are no surface water bodies at the site, this pathway will not be considered. Exposure concentrations will be based on the highest measured concentrations at each sample location. Groundwater samples will be compared to the MDH HRLs or other applicable groundwater criteria. Summary tables will include comparisons to SRVs and HRLs. Exceedences will be indicated in bold typeface.

The report will also provide a discussion of potential response actions to address environmental impacts in SOC 5. Based on the preliminary conceptual release models presented in this Work Plan, potential response actions include soil excavation with off-site disposal.

Based on results of this investigation, additional data collection activities may be required to further define the magnitude and extent of releases at the site. If additional data collection activities are needed, plans for those activities will be communicated to the MPCA and the work will be conducted prior to finalizing the report.

6.2 Schedule and Timeline

The approximate timeline for the Phase II Investigation is as follows:

- June 24, 2009—Work Plan submitted for MPCA review.
- July 15, 2009—Work Plan approved by MPCA Superfund Program.
- July 24, 2009—Preparation of bid documents and contracting.

- August 3, 2009—Field work begins.
- August 28, 2009—Field work completed.
- September 18, 2009—Final laboratory results received.
- November 30, 2009—Final Report submitted to MPCA.

It is anticipated that MPCA review of this Plan will require about three weeks. If review requires additional time, the above schedule will be adjusted accordingly.

After the investigation described in the Plan is complete, the scope of any additional investigation the need for remediation will be evaluated and discussed with the MPCA. Additional investigation activities will be addressed in a future plan submittal along with a corresponding schedule.

7.0 References Cited

- ASTM, 2005. Standard Practice for Environmental Site Assessments. Phase I Environmental Site Assessment Process. November 2005 ASTM International, 200 Bar Harbor Drive West, Conshohocken, PA.
- Barr Engineering Company, 2008a. *Review of Draft Focused Site Investigation (FSI) Report, Former Gopher Ordnance Works, Rosemount, Minnesota.*
- Barr Engineering Company, 2008b. *Draft Phase II Investigation Work Plan, UMore Mining Area, Dakota County, Minnesota.*
- Barr Engineering Company, 2009a. *Phase II Investigation Work Plan, SOC's 1-3 and 6-8, UMore Mining Area, Dakota County, Minnesota.*
- Barr Engineering Company, 2009b. *Groundwater Assessment Report, Resource Document for Environmental Impact Statement, UMore Mining Area, Dakota County, Minnesota. (In Production)*
- Bay West, 2009. *Final – Focused Site Inspection Report, Former Gopher Ordnance Works, Rosemount, Minnesota.*
- Dakota County (MN), 2006. Dakota County GIS Data (GOW_Areas_Operational_Area_AOC_UTM).
- Dakota County, 2008. GIS Coverage Showing Well Locations, UMore Park, Dakota County, Minnesota
- EDR, 2008. The EDR Radius Map Report with GeoCheck and Certified Sanborn Map Report, UMore Park, Rosemount, Minnesota 55068
- Girtz Pers. Communication, 2008. Meeting with Gordon Girtz of the University of Minnesota regarding past spill response and remediation locations within the UMA. October 24, 2008.
- Jefferds, 1947. Memorandum to War Assets Administration regarding Inspection of Decontaminated Areas, Gopher Ordnance Works, April 28, 1947.
- Metropolitan Council, 2008. Twin Cities Metropolitan Area Regional Groundwater Flow Model Version 2.00: Technical Report in Support of the Metropolitan Area Master Water Supply Plan (Draft)
- Minnesota Department of Agriculture, 2005. *Soil Sampling Guidance, Guidance Document 11, November 2005.*
- Minnesota Department of Natural Resources (DNR), DNR 24K Streams at <http://deli.dnr.state.us/>, accessed May 2009.
- Minnesota Geological Survey, 2006. County Well Index, update November 3, 2006

- Minnesota Geologic Survey, 1990. *Geologic Atlas, Dakota County, Minnesota (Atlas C-6)*.
- Minnesota Pollution Control Agency (MPCA), 1998. Risk Based Site Characterization and Sampling Guidance, Draft Guidelines, September 1998.
- MPCA, 2005. Risk-Based Guidance for the Soil-Human Health Pathway User's Guide, Tier 2 SRV table, November 2005.
- MPCA, 2008. Superfund and Emergency Response Section, Remediation Division, Guidance for Collection of Spatial Data, Publication C-S4-02.
- NOAA Satellite and Information Service, 2008. Monthly Station Climate Summary for St. Paul, Minnesota, <http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl>.
- Peer, 1994. Letter to Mr. Don Milles of MPCA from Thomas McMullen of Peer summarizing previous reports and providing soil and groundwater and SVE system data in support of closure for LEAK #2529, August 30, 1994.
- Peer, 2001. *Comprehensive Summary Report and Site Investigation and Corrective Actions* for AgSpill File# 14388, 14389, and 4783, UMore Park, Rosemount, MN. Prepared for the University of Minnesota by Peer Environmental and Engineering Resources, Inc., April 2001.
- Peer, 2006. *Phase I Environmental Site Assessment, UMore Park, Rosemount, Minnesota*, Prepared for the University of Minnesota by Peer Environmental and Engineering Resources, Inc.
- STS Consultants, Ltd, 1991. *Soil Exploration/Remedial Investigation, Rosemount Agricultural Experiment Station Petroleum Release Site*.
- USACE, 2006. *Preliminary Assessment Report Final 1947 Quitclaim Property, Former Gopher Ordnance Works, Rosemount, Minnesota*.
- United States Department of Agriculture, 2008. Dakota County Soil Survey, Minnesota, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>