

**SUMMARY REPORT FOR THE  
ATLAS POWDER EXPLOSIVES  
SITE ASSESSMENT  
SENER, HOUGHTON COUNTY, MICHIGAN**

Prepared for:

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
Region V Emergency Response Branch  
801 Garfield Avenue, No. 229  
Traverse City, Michigan 49686

Prepared by:

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U.S. EPA On-Scene Coordinator	Ralph Dollhopf

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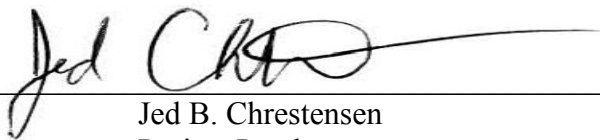
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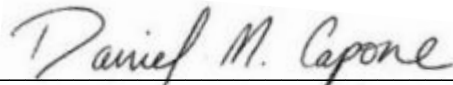
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Date 2/17/2010

Reviewed and  
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Daniel M. Capone  
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Date 2/17/2010



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## LIST OF ABBREVIATIONS AND ACRONYMS

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AMSL	Above mean sea level
COCs	Chemicals of concern
yd <sup>3</sup>	cubic yards
DNRE	Michigan Department of Natural Resources and Environment
DWC	Drinking Water Criteria
EPIC	Environmental Photographic Interpretation Center
ERD	Environmental Response Division
GPS	Global positioning system
MCL/AL	Maximum Contaminant Level/Action Level
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg/kg	Milligram per kilogram
NREPA	Natural Resources and Environmental Protection Act
OSC	On-Scene Coordinator
PCS	Pre-CERCLIS Screening
Pre-CERCLIS	Pre-Comprehensive Environmental Response, Compensation, and Liability Information System
RAT	Rapid Assessment Tool
RDCC	Residential Direct Contact Criteria
SA	Site Assessment
START	Superfund Technical Assessment and Response Team
SVOCs	Semi-volatile Organic Compounds
TNT	Trinitrotoluene
U.S. EPA	United States Environmental Protection Agency
VOCs	Volatile organic compounds
WESTON	Weston Solutions, Inc.
XRF	X-ray fluorescence

## 1. INTRODUCTION

The United States Environmental Protection Agency (U.S. EPA) tasked the Weston Solutions, Inc. (WESTON<sup>®</sup>), Superfund Technical Assessment and Response Team (START) to perform a Site Assessment (SA) at the Atlas Powder Explosives Site in Senter, Houghton County, Michigan. The U.S. EPA requested that WESTON START prepare the necessary planning documents, including a health and safety plan, review historical documents, assist with site reconnaissance and screening activities, assist with collection of soil samples, and evaluate threats to human health, human welfare, and the environment posed by site-related conditions under Technical Direction Document number S05-0001-0811-010. In addition to conducting preliminary reconnaissance at the site, WESTON START assisted with SA activities from July 27 through July 30, 2009 and September 15 through September 17, 2009, under the direction of U.S. EPA On-Scene Coordinator (OSC) Ralph Dollhopf.

This Summary Report is organized into the following sections:

- **Introduction** – Provides a brief description of the objectives and scope of SA activities;
- **Site Background** – Details the site description, features, historical background, and discusses potential contaminants of concern based on the site history;
- **Site Assessment Activities** – Discusses the methods and procedures used during the SA;
- **Field Screening and Analytical Results** – Discusses the results of field screening and laboratory samples collected during the SA;
- **Conclusions** – Provides a summary of the SA findings; and,
- **References** – Lists references used to prepare this report.

## 2. SITE BACKGROUND

The following subsections provide a limited description of the site and surrounding properties and provide a brief historical summary pertaining to previous operations in the vicinity of the subject investigation area.

## 2.1 SITE DESCRIPTION

The site is located northwest of the intersection of East Grosse Pointe Shores Road and Senter Road in Senter, Houghton County, Michigan. The former Atlas Powder Company historically encompassed a large area around Senter, Michigan as depicted in **Figure 1** (area depicted as Study Area). For the purposes of this report, the main investigation area (Site) is limited to an historical buried debris area located in the southwest quarter of Section 6 and the southeast quarter of Section 1, Township 54 North, Range 32 West and Township 54 North, Range 33 West, respectively (**Figure 1** - observed area of buried drums).

The buried debris area covers 1.67 acres and is located on a parcel owned by Mr. Brian Hurt, previously owned by Mr. George Matayas. Ownership of the property was transferred in May 2008. The historical buried debris area was reportedly operated by the former Atlas Powder Company plant. The area is bound to the east, north, and west by property owned by Ms. Helen Smith and to the south by East Grosse Pointe Shores Road, which provides access to the parcel. The Hurt and Smith parcels are generally wooded with unimproved dirt roads and trails that intersect at various points on the properties. There are currently no structures present on the Hurt parcel. Title search information related to the Hurt and Smith properties is included in **Attachment A**.

The Site may be accessed from both Senter Road to the east and East Grosse Pointe Shores Road to the south with the latter being the preferred access route as it requires access to only the Hurt property. Although there is little development along Senter Road, East Grosse Pointe Shores Road provides access to numerous waterfront properties located along the southeast side of the road. In addition, several homes are located along the north side of East Grosse Pointe Shores Road, generally to the northeast where East Grosse Pointe Shores Road intersects Senter Road. The properties in the vicinity of the investigation area are serviced by private water supply wells. In addition, an artesian seep exists approximately 250 feet south of the southwestern extent of the buried debris.

## 2.2 PHYSICAL FEATURES OF THE SITE

The general topography at the Site slopes from the north to the south/southeast towards Portage Lake/Torch Bay with a change in topographic relief of approximately 680 feet above mean sea level (AMSL) along the northern limits of the Site to a mean lake elevation of approximately 602 feet AMSL to the south.

The buried debris area is located north of Grosse Pointe Shores Road, between topographic elevations of approximately 680 feet AMSL and 620 feet AMSL. The area is bordered on the north by an unimproved access road, roughly oriented from east to west and positioned atop an embankment. Towards the south from the access road, the embankment slopes sharply, varying in height from several feet to over 10 feet, with the greater elevations towards the east.

The buried debris area is located along the toe of the south sloping embankment with debris and waste materials observed along the embankment, and spreading south along the more gently sloping toe of the embankment. The debris field extends south/southeast to a maximum distance of approximately 200 feet, east to west along the access road approximately 600 feet, encompassing an area of approximately 72,744 square feet (**Figure 2**). The debris and waste materials on the ground surface may have been deposited from north to south, filling in the generally southward sloping native ground surface. Debris or evidence of buried debris does not exist north of the access road.

Groundwater flow in the area is unknown; however, based on the proximity of the investigation area to Portage Lake, as well as the observed artesian seep identified south of the investigation area, it is presumed that groundwater flow is to the south/southeast toward Portage Lake.

## 2.3 SITE BACKGROUND

Site background information was obtained from the following sources:

- Michigan Department of Natural Resources (MDNR), Environmental Response Division (ERD) communications and documentation, January 1989 through October 1989;
- Student research summarized in a report titled *Atlas Powder Company, Senter Plant* conducted by Michigan Technological University students Baer and Bednark, February 1988;

- Student research summarized in a report titled *Magnetic Survey Analysis* conducted by Michigan Technological University students Matthews and Duvendack, July 1989;
- Personal conversations with Mr. James Spence, Director of Cardiopulmonary, Portage Health, Houghton, Michigan;
- Written historical accounts in a book titled *Atlas Powder: Senter, Michigan 1910-1960* by Bill Haller, 2007;
- Aerial photographs obtained from the Michigan Department of Environmental Quality's (MDEQ) Geological Services Unit;
- Aerial photographs obtained from the U.S. EPA's Environmental Photographic Interpretation Center (EPIC) (**Attachment B**); and
- Historical photographs documented by various local historians and archivists.

As summarized from the documents listed above, the Atlas Powder Company produced dynamite and nitroglycerin for local copper mines at the plant in Senter, Michigan from 1910 to 1960, until decreased demand and changes in manufacturing processes closed the plant. As with many such facilities from this era and due to the hazardous and volatile nature of the plant operations, the Atlas Powder Company operations at Senter were essentially a city unto itself, encompassing approximately 1,815 acres. The plant was originally constructed and owned by the DuPont Company 1909, but later became a subsidiary, producing explosives in support of the mining activities and World War 1. The facility grew to include a number of production facilities and storage structures as well as utilities such as a power house and both documented and undocumented disposal areas or landfills. Following the plant closure in 1960, the buildings and structures at the facility were abandoned or raised and as documented in historical photographs, became a remote location for the accumulation of refuse and debris, presumably from illegal dumping.

In the late 1980s, the Torch Lake Superfund Site was being developed and local residents reported to the MDNR and the U.S. EPA concerns related to the abandoned facilities of the former Atlas Powder Company. In addition to dilapidated buildings, accounts of possible buried waste and drums were also reported. Inspection of the former Atlas Powder Company property by MDNR ERD personnel in October 1989 concluded that "...many abandoned structures and

junk cars are present. Additional investigation may be warranted should complaint(s) be able to identify specific chemical dumping areas.”

Interest in the abandoned Atlas Powder Company facility was revisited in a letter to the MDEQ, postmarked September 18, 2008. The letter, from a resident that lives along East Grosse Pointe Shores Road, inquired about reported illnesses and several deaths of residents living along East Grosse Pointe Shores Road and their potential link to historic Atlas Powder Company plant. A review of cancer incidence rates for Houghton and Keweenaw Counties was conducted by a toxicologist at the Michigan Department of Community Health (MDCH) to evaluate public health implications related to exposure from contamination remaining from historical industrial operations in the area. Based on the available reports and incidence rates, it was concluded that there was not a statistically significant difference in state and county incidence rates for cancer. The findings of the MDCH review were provided to the interested resident in a letter dated October 22, 2008. As a result of the resident’s inquiry, the MDEQ in cooperation with the U.S. EPA initiated planning and coordination activities to collect environmental data from the private water supply wells and to further investigate the reported drum and debris burial area north of East Grosse Pointe Shores Road.

## **2.4 POTENTIAL CHEMICALS OF CONCERN (COCs)**

Based on the historical operations of the Atlas Powder Company plant, a variety of COCs have the potential of being present in the soil and groundwater beneath the Site. Trinitrotoluene (TNT) is a yellow solid commonly used in the production of dynamite; however, the Atlas Powder Company reportedly only produced nitroglycerin-style dynamite at the Senter location. As a result, TNT and dinitrotoluene were not considered potential COCs. Nitrates were used at the Site in the production of nitroglycerin and are also a breakdown product of nitroglycerin in the environment. In addition, to the manufacturing of such chemicals, the facility also reportedly housed lead-lined structures that were demolished and/or incinerated on the property.

As a result of the known activities at the Site and for the purposes of screening the unknown contents of abandoned, buried, or dilapidated containers and drums, a select number of COCs was established to characterize the Site as well as screen the nearby private water wells for potential



impacts. The following provides a summary of the potential COCs evaluated as part of the SA activities at the Site:

- General chemistry for surface water and residential well samples, including:
  - Chloride;
  - Flouride;
  - Hardness;
  - Iron;
  - Nitrate;
  - Nitrite;
  - Sodium; and,
  - Sulfate.
- Select metals for soils, surface water, and residential well samples, including:
  - Aluminum;
  - Arsenic;
  - Barium;
  - Cadmium;
  - Chromium;
  - Copper;
  - Iron;
  - Lead;
  - Manganese;
  - Mercury;
  - Selenium; and,
  - Zinc.
- Volatile organic compounds (VOCs) for surface water and residential well samples; and,
- Semi-volatile organic compounds (SVOCs) for surface water and residential well samples.

Soil, surface water, and groundwater were considered relavant sample media relating to the transport and migration of potential COCs from the Atlas Powder Company Site and more specfically the identified buried debris area.

### **3. SA ACTIVITIES**

The SA activities at the Site were essentially conducted in two phases with a Pre-Comprehensive Environmental Response, Compensation, and Liability Information System (Pre-CERCLIS)

Screening assessment conducted from July 27 through July 30, 2009 and a focused SA conducted from September 15 through September 17, 2009.

Both the Pre-CERCLIS Screening (PCS) assessment and the focused SA were completed as a cooperative investigation between the U.S. EPA and the Michigan Department of Natural Resources and Environment (DNRE). WESTON START personnel supported the initial Site reconnaissance activities and each subsequent phase of the SA activities. The U.S. EPA OSC, Mr. Ralph Dollhopf, provided direction and guidance for the planning of each phase of the SA and coordinated the implementation of the on-site activities. In general, the SA included the following tasks:

- Visual assessment of Site features, structures, and exposed debris or materials;
- Site reconnaissance, including staging and sampling location determination;
- Passive magnetic geophysical survey;
- X-ray fluorescence (XRF) analyzer screening of soils for metals;
- Installation of intrusive test trenches and XRF screening of test trench soil and debris; and,
- Soil sample, residential well sample, and surface water sample collection for laboratory analysis of potential COCs.

The following sections provide a detailed summary of the reconnaissance and SA activities conducted at the Site to evaluate existing evidence indicating that waste materials and/or explosive materials may have been buried in drums or containers at or near the Site.

### **3.1 PRELIMINARY SITE RECONNAISSANCE**

Prior to the initiation of the SA, WESTON START and Ms. Amy Keranen of the DNRE completed several reconnaissance visits to the Site. The intent of the preliminary Site reconnaissance was to assist in the coordination and implementation of the SA activities. In general each Site reconnaissance visit had specific goals for obtaining relevant information related to the subject properties and potential human and environmental receptors.

On May 7, 2009 a visual inspection of the Site was conducted by Ms. Keranen of the DNRE and three primary access routes that enter the property in the vicinity of the area of investigation were identified.

The access routes were evaluated and described as follows:

- The first route was generally overgrown with vegetation and was perceived to be impassable by off-road vehicles.
- The remaining two routes were described as narrow, unimproved roads that were gated or otherwise blocked to vehicular access.

Regarding vegetation in the subject area, trees appeared to be densely spaced within the subject footprint, potentially limiting access and satellite communication associated with global positioning system (GPS) devices. Further, mobile phone coverage was reportedly limited at the Site, adding additional complexities to the performance of the pending SA.

On June 15, 2009, WESTON START personnel and the DNRE revisited the Site to further evaluate planning logistics and to collect additional GPS data to further define the buried debris area. Observations and GPS coordinates collected by WESTON START and the DNRE during this Site visit are summarized on **Figure 2**.

During the Site visit, observed debris predominantly consisted of metal drums, metal containers, and ceramic pipe pieces. However, other material such as auto parts, sheet metal, metal banding, beverage containers, industrial lighting, and household wastes were also noted on the ground surface. A downward embankment was observed along a majority of the southern limit of the investigation area and buried debris was visible protruding from the embankment wall. The embankment varied in height from several feet to over 10 feet, with the higher elevations toward the east end.

Based on the topographical observations, it was inferred that the debris and materials observed on the ground surface may have been deposited from north to south, filling in the generally southward sloping native ground surface until the fill was approximately level with what is now the access road. Debris was not observed north of the access road.

In addition, GPS reception was determined to be good, with decreasing satellite reception in the western portion of the investigation area where the trees were larger and tree canopy coverage was more extensive.

## 3.2 FIELD SCREENING AND SAMPLING ACTIVITIES

Following completion of the preliminary reconnaissance of the Site, an approach for implementing the investigative activities was developed. Two separate field screening and sampling events were planned at the Site. The first event consisted of the PCS assessment and focused on a geophysical survey and an initial assessment and screening of surface soils and debris within the buried debris area. The second event expanded the SA to include intrusive investigative techniques (test trenching and sampling), based on the results of the previous screening event. The following subsections provide a detailed account of the investigative strategies and exploratory methods deployed during each event.

### 3.2.1 PCS Assessment (July 2009)

In a collaborative effort between the DNRE and the U.S. EPA, a PCS assessment was conducted at the Site from July 27 through 30, 2009. The purpose of the PCS assessment was to determine the potential that historical industrial activities may have resulted in impacts detrimental to human health and the environment specific to the buried debris area. An additional objective of the PCS assessment was to determine the need for potential emergency removal actions at the Site. The scope of work to be performed under the PCS assessment is described in detail in a document prepared by the DNRE entitled *Pre-CERCLIS Screening Assessment Work Plan for Atlas Powder, Senter, Michigan* (May 11, 2009).

During this PSC assessment, the U.S. EPA, WESTON START, and the DNRE performed a visual inspection of the buried debris area, identifying and mapping specific areas of waste and debris on the ground surface or partially buried. In addition, areas of the Site exhibiting topographic features, such as mounding or depressions, possibly indicative of buried debris were also recorded and logged utilizing a sub-meter GPS device (Trimble). Concurrent with the visual survey, personnel from the U.S. EPA Field Services Section comprised of a geophysicist and a scientist performed a passive magnetic survey over the entire area of observed buried debris. U.S. EPA personnel utilized a Geometrics G-858 magnetometer in total field mode, minus a background of 57,000 gammas, to map the Site. The results of the passive magnetic survey are depicted on **Figure 3** and are discussed in Subsection 4.1. The findings of the visual inspection,

including the locations and descriptions of debris and suspect physical features, are depicted on **Figure 4** and discussed in Subsection 4.1. Finally, the observed debris areas overlain on the geophysical survey lines are depicted on **Figure 5**.

Following the initial magnetometer survey and the visual screening of the Site, a random sampling grid was established over the buried debris area and grids were screened utilizing the U.S. EPA's Rapid Assessment Tool (RAT) software that assigns GPS coordinates to real-time data and allows for the ability to evaluate field data as they are being generated. The grid sampling design was developed using the Visual Sampling Plan software to establish the locations for screening. An Innov-X (Model 2000) XRF instrument was linked to RAT and used to screen soils for metals contamination at each of the established grid nodes.

All XRF field screening locations were located using a sub-meter GPS device (Trimble). In total, WESTON START and U.S. EPA collected XRF data from 52 screening locations (grid nodes), identified as ap-01 through ap-52. In addition to screening the established grid nodes, XRF data was collected from suspect locations that were identified either by the geophysical survey or visual inspection activities. Suspect locations identified during the passive magnetic survey were flagged by the geophysical survey team as areas with elevated magnetic properties. Subsequently, each location was given a unique identifier (MAGPILE 01 through MAGPILE 34), flagged, and screened with the XRF and RAT. Similarly, 27 other locations ranging from the roadway, wetlands, and a nearby sand pit were also screened with the XRF to further evaluate the presence of metals contamination in the near surface soils. XRF screening results are summarized on **Table 1** and discussed in Subsection 4.1.1. XRF screening locations are depicted on **Figure 6**.

### **3.2.2 Intrusive Investigation and Sampling (September 2009)**

The findings of the PCS assessment lead to the development of a secondary scope of work for performance of focused SA activities, including the performance of intrusive test trenching, additional screening, and the collection of biased soil and water samples from select areas of the Site and nearby properties.

On September 15, 2009 the U.S. EPA, WESTON START, and the DNRE returned to the Site to perform the focused SA activities. The planned activities included the installation of up to eight test trenches at select locations within the buried debris area. The test trenches were installed to investigate anomalous features identified during the PCS assessment. Due to the nature of the potential hazards at the Site, WESTON START personnel specializing in Explosive Ordnance Disposal and assessment of Unexploded Ordnance were on-site to perform the test trenching activities.

Prior to the initiation of excavation activities, WESTON START coordinated the location of utilities using Michigan's one-call utility locating service, MISS Dig System, Inc. Following establishment of a staging area and a review of the scope of work with all Site personnel, it was determined that the test trenching activities would be initiated in the western portion of the buried debris area and progress east across the Site until each of the test trenches were excavated, observed, screened and potentially sampled, and restored. Preparation for test trenching required that trees and fallen timber be removed so that the excavating equipment could access the selected areas. Test trench locations for test trenches TT-1 through TT-8 are depicted on **Figure 7**. The following provides a summary of the physical descriptions recorded for each test trench excavated on September 15 and 16, 2009:

- TT-1: An abundance of metal wire, debris, and metal banding was observed in the upper one foot of the test trench. Drums and similar containers were not discovered.
- TT-2: Household waste and debris was observed in the test trench, but drums and similar containers were not discovered.
- TT-3: An abundance of construction debris and some household debris was observed in the test trench, but drums and similar containers were not discovered.
- TT-4: An abundance of metal debris, glassware, and household waste was observed in the excavation. Commingled with the soil and debris was a small amount of "orange solid material". The material was sampled and tested with an Expray Explosives Detection Kit, an aerosol-based field test kit for the detection and identification of Group A explosives, Group B explosives, and compounds containing inorganic nitrates. All three tests were negative for explosives.
- TT-5: An abundance of metal wiring and several pieces of ceramic piping were observed in the excavation. Drums and similar containers were not discovered.

- TT-6: An abundance of metal debris was observed near the ground surface, including metal screening and corrugated metal siding. Metal debris was not observed at depth within the excavation.
- TT-7: Metal banding was observed in the excavation, but drums and similar containers were not discovered.
- TT-8: An abundance of metal debris was observed near the ground surface, however similar debris was not observed at depth within the excavation.

Refer to the photographic log included in **Attachment C** for additional details related to the test trenches.

In addition to recording observations from each test trench, WESTON START and DNRE personnel screened soils encountered within each test trench using a Niton XL3T 700 XRF. Up to five XRF readings were collected from each test trench (TT-1 through TT-8) and were recorded in the field log book as XRF-2 through XRF-28. XRF screening results collected from the test trenches are summarized on **Table 2**. Further, XRF screening locations (XRF-2 through XRF-28) were recorded using a GPS device and are depicted on **Figure 8**. Results of the XRF screening conducted within each test trench are discussed in Subsection 4.2.1.

Similar to the screening activities in the test trenches, DNRE personnel performed a walk-over of the investigation area and screened 29 additional surface soil locations using the XRF (XRF-30 through XRF-58). Four soil samples were collected with bias from select screening locations and submitted for laboratory analysis of select metals. A fifth surface soil sample was collected from an area north of the buried debris area near the sand pit. Rationale for collection of the surface soil samples was based on the XRF field screening and at the discretion of the DNRE personnel. The XRF screening results are summarized on **Table 2**. The sample locations for surface soil samples are depicted on **Figure 9**. Analytical results of surface soil samples are discussed in Subsection 4.2.2. A photographic log documenting the SA activities is included in **Attachment C**.

Surface soil samples were collected by DNRE personnel using DNRE protocols for sample collection. Surface soil samples were analyzed by the State of Michigan Environmental Laboratory in Lansing, Michigan for the following select metals:

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- Aluminum;
- Arsenic;
- Barium;
- Cadmium;
- Chromium;
- Copper;
- Iron;
- Lead;
- Manganese;
- Mercury;
- Selenium; and,
- Zinc.

Prior to shipping, the sample containers were tightly sealed and immediately packed upright on ice in coolers. Upon collection of all samples, the appropriate laboratory chain-of-custody forms were completed. Sample coolers were securely taped shut prior to transport to prevent tampering or loss of samples. Samples were shipped to the State of Michigan's Environmental Laboratory by overnight courier.

In addition to the collection of surface soil samples, the DNRE collected samples from numerous private potable wells in the area and surface water for analysis of the following potential COCs:

- General chemistry, including:
  - Chloride;
  - Flouride;
  - Hardness;
  - Iron;
  - Nitrate;
  - Nitrite;
  - Sodium; and,
  - Sulfate.
- Select metals, including:
  - Aluminum
  - Arsenic;
  - Barium;
  - Cadmium;
  - Chromium;
  - Copper;
  - Iron;
  - Lead;
  - Manganese;



- Mercury;
  - Selenium; and,
  - Zinc.
- VOCS; and,
- SVOCs.

Residential well and surface water samples were collected by DNRE personnel on multiple dates due to coordination with homeowners and access constraints. The following is a summary of the addresses and dates associated with the sampling of residential wells between July 2009 and September 2009:

- 27031 East Grosse Pointe Shores Road (7/09);
- 27005 East Grosse Pointe Shores Road (7/09);
- 26967 East Grosse Pointe Shores Road (7/09);
- 26961 East Grosse Pointe Shores Road (7/09);
- 26929 East Grosse Pointe Shores Road (7/09);
- 26921 East Grosse Pointe Shores Road (7/09 and 9/09);
- 26769 East Grosse Pointe Shores Road (9/09);
- 26711 East Grosse Pointe Shores Road (9/09);
- 26687 East Grosse Pointe Shores Road (8/09);
- 26603 East Grosse Pointe Shores Road (9/09);
- 26381 East Grosse Pointe Shores Road (8/09);
- 26359 East Grosse Pointe Shores Road (7/09);
- 26207 East Grosse Pointe Shores Road (9/09);
- 26187 East Grosse Pointe Shores Road (9/09);
- 26298 East Grosse Pointe Shores Road (9/09); and,
- 26147 East Grosse Pointe Shores Road (9/09).

Both surface water and residential well samples were collected by DNRE personnel using DNRE protocols for sample collection. Surface water and residential well samples were analyzed by the State of Michigan Environmental Laboratory. Residential well samples were collected using the following protocols:

- The well pump was allowed to run for at least 15 minutes to purge the well and plumbing system prior to sample collection;
- Samples were then collected from a spigot that bypassed any water treatment system, directly filling the sample bottles;
- The VOC bottle for each sample was field preserved with hydrochloric acid;

- The total metals bottle for each sample was field preserved with nitric acid; and
- The nitrate/nitrite bottle for each sample was preserved with sulfuric acid.

Prior to shipping, the sample containers were tightly sealed and immediately packed upright on ice in coolers. Upon collection of all samples, the appropriate laboratory chain-of-custody forms were completed. Sample coolers were securely taped shut prior to transport to prevent tampering or loss of samples. Samples were shipped to the State of Michigan's Environmental Laboratory by overnight courier.

## **4. FIELD SCREENING AND ANALYTICAL RESULTS**

The following subsections discuss the field screening, soil sampling, potable well sampling, and surface water sampling results obtained during SA activities.

### **4.1 PCS ASSESSMENT (JULY 2009)**

**Figure 3** depicts the anomalous features which were identified during the magnetic survey. There were approximately six areas identified containing elevated gamma readings across the buried debris area, indicating the potential presence of buried debris. These areas were targeted for further screening and/or investigation during the subsequent intrusive investigation event. **Figure 4** displays a summary of observed containers and other surface or partially buried debris identified during the PCS. **Figure 5** displays the observed debris and container information overlain on the geophysical survey information. This allowed for the correlation of observed debris areas with suspect anomalous features recorded by the magnetometer.

The following subsections provide a summary of the field screening and analytical data gathered during the PCS assessment.

#### **4.1.1 XRF Screening Results**

The XRF results collected during the July 2009 PCS assessment were compiled and are included as **Table 1**. The XRF screening results were compared to the DNRE Part 201 Residential Direct Contact Criteria (RDCC) to evaluate potential risks associated with exposure to soil within the buried debris area. For the purposes of screening for potential COCs, lead and arsenic

concentrations were considered markers of potential contaminant “hot spots” to be considered for investigation in following phase of the SA activities.

Only two locations (ap-05 and ap-29) of the 52 soil screening locations (ap-01 through ap-52) exceeded RDCC for arsenic (7.6 milligram per kilogram [mg/kg]). Of the remaining XRF screening locations that were identified by the geophysical survey or visual inspection, only four locations (TAR-1, MAGPILE-2, MAGPILE-2B, and AW2) exceeded RDCC for arsenic. The analytical results and estimated area of arsenic impact in surface soils is depicted on **Figure 8**. The highest concentration of arsenic was 467 mg/kg, at location MAGPILE-2, located within the buried debris investigation area.

Results of the XRF screening also indicated that 24 of the locations exhibited elevated concentrations of lead above the RDCC (400 mg/kg). Twelve of the locations were non-grid locations with the highest value of 10,815 mg/kg occurring at MAGPILE-2. Twelve of the grid locations exceeded RDCC, with the highest value of 12,676 mg/kg present at grid node ap-05. Similar to the recorded data for arsenic, elevated lead concentrations were located within the buried debris investigation area. The analytical results and estimated area of lead impact in surface soils is depicted on **Figure 9**.

Soil samples were not collected for laboratory analysis during the PSC assessment. Alternatively, screening data was used to focus the scope of work for the following phase of intrusive investigation.

#### **4.1.2 Laboratory Surface Water and Residential Well Sampling Results**

Seven residential well and one surface water samples were collected by DNRE personnel between July 29 and July 30, 2009. The following is a summary of the addresses and dates associated with the sampling of residential wells and surface water during the PCS assessment:

- 27031 East Grosse Pointe Shores Road (7/29/09);
- 27005 East Grosse Pointe Shores Road (7/29/09);
- 26359 East Grosse Pointe Shores Road (7/29/09)
- 26967 East Grosse Pointe Shores Road (7/29/09);
- 26961 East Grosse Pointe Shores Road (7/30/09);
- 26929 East Grosse Pointe Shores Road (7/29/09);

- 26921 East Grosse Pointe Shores Road (7/29/09); and,
- Surface water sample identified as Artesian Spring (7/30/09).

Two additional residential wells were sampled in August 2009 due to coordination with homeowners and access constraints. The following summarizes the two additional addresses and dates associated with the sampling of residential wells in August 2009:

- 26687 East Grosse Pointe Shores Road (8/7/09); and,
- 26381 East Grosse Pointe Shores Road (8/3/09).

The analytical results for surface water and residential well samples are summarized on **Table 3**. Two samples collected during July and August exceeded one or more of the general water quality parameters. The residential well sample collected from 26381 East Grosse Pointe Shores Road exceeded the established Maximum Contaminant Level/Action Level (MCL/AL) for nitrates of 10,000 µg/l. The concentration of nitrates for the sample collected from 26381 East Grosse Pointe Shores Road was 10,200 µg/l. The sample collected from 26359 East Grosse Pointe Shores Road had an iron concentration of 8,000 µg/l, exceeding the DNRE Residential Health-Based Drinking Water Value. No samples collected during July and August exceeded criteria for VOCs or SVOCs.

Aluminum, iron, and/or manganese exceeded DNRE Part 201 Criteria for groundwater at four of the sample locations, including the artesian spring which had a concentration of aluminum of 120 µg/l. Three of the residential well sample locations had the following concentrations of metals which exceeded select DNRE Part 201 Criteria:

- 27005 East Grosse Pointe Shores Road: iron – 2,250 µg/l and manganese – 70 µg/l;
- 26359 East Grosse Pointe Shores Road: iron – 6,880 µg/l and manganese – 80 µg/l; and,
- 26921 East Grosse Pointe Shores Road: iron – 590 µg/l.

For the purpose of evaluating data, the laboratory analytical results were compared to the most conservative (lowest) DNRE Part 201 Criteria for each analyte. The DNRE Part 201 Criteria used for comparison of laboratory analytical results included Residential Health-Based Drinking Water Value for iron (2,000 µg/l) and the Residential Health-Based Drinking Water Value for manganese (860 µg/l). The Residential and Commercial I Drinking Water Criteria (DWC) for iron (300 µg/l) and manganese (50 µg/l) is less than the Residential Health-Based Drinking

Water Value for each COC. The Residential and Commercial I DWC is the aesthetic drinking water value, as required by Section 20120a(5) of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). A notice of aesthetic impact may be employed as an institutional control mechanism if groundwater concentrations exceed the aesthetic drinking water criterion, but do not exceed the applicable health-based drinking water value.

The Residential and Commercial I DWC for aluminum is 50 µg/l. The Residential and Commercial I DWC is the aesthetic drinking water value as required by Section 20120(a)(5) of the NREPA. Concentrations up to 200 µg/l may be acceptable, and still allow for drinking water use, as part of a site-specific cleanup under Section 20120a(2) of the NREPA.

## **4.2 INTRUSIVE INVESTIGATION AND SAMPLING**

The findings of the PCS assessment lead to the development of a secondary scope of work for performance of focused SA activities, including the performance of intrusive investigations, additional screening, and the collection of soil and residential well samples from select areas of the Site and nearby properties. The second phase of the SA was conducted from September 15 through 17, 2009, and expanded the SA to include intrusive investigative techniques, based on the results of the previous screening event. The following subsections provide a summary of the field screening and analytical data gathered during the September 2009 SA activities conducted at the Site.

### **4.2.1 XRF Screening Results**

The XRF results collected during the September 2009 SA activities were summarized in **Table 2**. The XRF screening results were compared to the DNRE Part 201 RDCC to evaluate potential risks associated with exposure to soil within the buried debris investigation area. The XRF screening locations and results that exceeded criteria are depicted on **Figure 10**.

As described previously, up to five XRF screening locations were established in each of the eight test trenches. Only test trench TT-6 did not contain elevated screening results for lead, arsenic, and/or iron in any of the sample locations. The following provides a summary of the test

trenches, the XRF screening location, and the resultant exceedance for lead, arsenic, and iron. The bold concentration indicates the maximum measured value:

- TT-1
  - XRF 25: lead (1,438 mg/kg)
  - XRF 27: lead (1,017 mg/kg) and arsenic (77 mg/kg)
  - XRF 28: lead (1,136 mg/kg) and arsenic (92 mg/kg)
- TT-2
  - XRF 20: lead (1,881 mg/kg)
  - XRF 21: lead (501 mg/kg)
  - XRF 21: lead (566 mg/kg) and arsenic (65 mg/kg)
- TT-3
  - XRF 23: lead (2,950 mg/kg)
  - XRF 24: lead (766 mg/kg)
- TT-4
  - XRF 18: lead (794 mg/kg) and iron (531,671 mg/kg)
  - XRF 19: lead (1,419 mg/kg) and arsenic (113 mg/kg)
- TT-5
  - XRF 15: arsenic (15 mg/kg)
- TT-7
  - XRF 7: iron (307,072 mg/kg), lead (10,709 mg/kg), and arsenic (841 mg/kg)
  - XRF 8: arsenic (29 mg/kg)
  - XRF 9: lead (1,020 mg/kg)
- TT-8
  - XRF 12: arsenic (13 mg/kg)
  - XRF 14: lead (668 mg/kg) and arsenic (53 mg/kg)

Subsequent to the completion of the test trenching activities, DNRE personnel performed a walk-over of the buried debris investigation area and screened 29 additional surface soil locations using the XRF (XRF-30 through XRF-58). The GPS coordinates for these results were not recorded; however DNRE personnel used the screening results to establish surface soil sampling locations discussed further in the following subsection.

#### **4.2.2 Laboratory Surface Soil Sampling Results**

Four soil samples were collected with bias from select screening locations and submitted for laboratory analysis. A fifth surface soil sample was collected from an area north of the buried debris investigation area, near the sand pit. Rationale for collection of the surface soil samples was based on the XRF field screening and at the discretion of the DNRE personnel. The surface

sample locations and their respective Part 201 RDCC exceedances are depicted on **Figure 11**. The analytical results of the surface soils are summarized on **Table 4**.

Soil samples were analyzed for metals and similar to the XRF screening results exhibited concentrations of lead and arsenic that exceeded Part 201 RDCC. An arsenic concentration of 16 mg/kg was measured in soil sample location SS-1 which exceeded Part 201 RDCC (7.6 mg/kg). Sample SS-1 was the only soil sample to exhibit a concentration of arsenic that exceeded Part 201 RDCC.

Soil samples collected from locations SS-1 through SS-4 exceeded Part 201 RDCC for lead. Laboratory analysis included both a coarse and fine fraction for analysis. The maximum concentration of the lead detected in the soil samples was from location SS-4 (46,000 mg/kg) from the coarse fraction of the sample. Laboratory analytical results for the sample collected from location SS-5, the background location, exhibited metals concentrations that were all below Part 201 RDCC.

#### **4.2.3 Laboratory Surface Water and Residential Well Sampling Results**

One surface water and eight residential well samples were collected by DNRE personnel between September 16 and 17, 2009. The analytical data is summarized in **Table 3**. The following is a summary of the addresses and dates associated with the sampling of residential wells and surface water during the September SA activities:

- 26921 East Grosse Pointe Shores Road (9/16/09);
- 26769 East Grosse Pointe Shores Road (9/16/09);
- 26711 East Grosse Pointe Shores Road (9/16/09);
- 26603 East Grosse Pointe Shores Road (9/17/09)
- 26207 East Grosse Pointe Shores Road (9/16/09);
- 26187 East Grosse Pointe Shores Road (9/16/09);
- 26298 East Grosse Pointe Shores Road (9/16/09);
- 26147 East Grosse Pointe Shores Road (9/16/09); and,
- Surface water sample identified as SW-1 (9/17/09).

Iron was the only metal detected in residential wells sampled in September 2009 that exceeded DNRE Part 201 Criteria at location 26921 East Grosse Pointe Shores Road. The surface water

sample (SW-1) contained concentrations of 70 µg/l for aluminum, 1,660 µg/l for iron, and 240 µg/l for manganese.

The residential well at 26921 East Grosse Pointe Shores Road was the only residential well sampled during both the July and September sampling events. The measured concentration of iron from September sampling event was consistent with the previously measured concentration of iron (590 µg/l). No samples collected during September 2009 exceeded Part 201 Criteria for general water quality parameters, VOCs, or SVOCs.

The sample locations and laboratory analytical results for select COCs are depicted on **Figure 12**. Sulfate detections are summarized on **Figure 13** and nitrate detections and exceedances are summarized on **Figure 14**.

## 5. CONCLUSIONS

The PCS assessment and the focused SA activities were completed as a cooperative investigation between the U.S. EPA and the DNRE. WESTON START personnel supported the initial Site reconnaissance activities and each subsequent phase of the SA activities. The U.S. EPA, DNRE, and WESTON START completed a variety of SA activities at the Site with the objective of evaluating threats to human health, human welfare, and the environment posed by Site-related conditions.

SA activities began with the completion of a detailed file review of historical documents. The findings of this task confirmed the operational limits of the former Atlas Powder Company and also focused the investigative work to a historically reported waste and debris burial area. This historical information in conjunction with an inquiry from a local resident near the Site prompted the follow-up field SA activities.

Following the historical document search and review, U.S. EPA, WESTON START, and the DNRE completed field-focused SA activities. These activities involved Site reconnaissance, completion of a geophysical magnetometer survey, mapping of visual debris and waste materials, XRF screening of soils and debris for metals, residential well and surface water sampling,



installation of test trenches within the buried debris area, and collection of soil samples for laboratory analysis of potential COCs. Results of the SA indicate that soils from numerous areas throughout the buried debris area exhibit concentrations of arsenic, lead and iron exceeding the MDEQ Part 201 RDCC. Residential well analytical results determined that one residential well exceeds the MCL/AL for nitrates and three residential wells exceeded select Part 201 Criteria for aluminum, iron, and manganese. The surface water sample and the artesian spring sample collected from the area contained similar concentrations of metals consistent with those measured in the residential well samples.

Based on the sampling results, metals contamination, specifically lead and arsenic that exceeds Part 201 RDCC was identified in the surface soils at the Site; however, the vertical extent of soil contamination at the Site is unknown. The presence of VOCs, SVOCs, and explosives were not identified in any of the soil, surface water or groundwater samples. Nitrates, which were used at the Site in the production of nitroglycerin and are also a breakdown product of nitroglycerin in the environment, were however detected above Part 201 Criteria in one residential well sample.

Metals contamination above Part 201 RDCC presents immediate threats to human health and the environment that should be considered when evaluating potential future actions at the Site. Human and biological receptors are present due to foot traffic, off-road vehicle traffic, and animal behavior in the vicinity of the buried debris investigation area. Further, potential receptors outside of the investigation area are present due to the erosion of surface soils by both weather and animal and human traffic in the area. These mechanisms have the ability to transport soil from the investigation area and increase the potential for exposure outside of the investigation limits.

Based on the soil screening results and laboratory analytical data, WESTON START has developed a preliminary volume estimate range that would include the removal of 1 to 3 feet of contaminated soil and debris from the ground surface. Metals contamination in excess of Part 201 RDCC covers an area of approximately 13,100 square feet. A removal action to a depth of 1 foot in this area would result in the excavation of approximately 485 cubic yards (yd<sup>3</sup>) of contaminated soil and debris, or approximately 730 tons. Similarly, based on observations

during test trench installations, the removal of metals contaminated soil to an increased depth of 3 feet would mitigate the presence of metals contaminated soil and debris in the shallow subsurface. A removal action to a depth of 3 feet would result in the excavation of approximately 1,455 yd<sup>3</sup> of contaminated soil and debris, or approximately 2,185 tons. The estimated range of soil volumes (485 to 1,455 yd<sup>3</sup>) should be considered further for planning purposes, as observed conditions at the Site did not identify a uniform distribution, neither vertically nor horizontally, of waste and debris.

The volume estimates for each removal option does not include the removal of surface vegetation and/or stumps that would be required for such an undertaking. Further, access to the area of contamination remains limited and would require substantial improvement to allow for access by equipment, haul trucks, and related construction appurtenances.

The removal of potentially contaminated soil from depths greater than 1 to 3 feet may also be considered; however, development of the parcel is unlikely and no subsurface utilities or utility easements are present on the property, which would increase exposure risks to construction or utility workers. Future development of the property should consider the presence of soil contamination at greater depths, but at this time it is not considered an immediate exposure risk.

## 6. REFERENCES

**Baer and Bednark, 1988,** Atlas Powder Company, Senter Plan – Research Paper. February 1988.

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**Haller, 2007,** Atlas Powder: Senter, Michigan 1910-1960. Author published, Houghton, Michigan, 2007.

**MDNR - ERD, January 1989 - October 1989,** Correspondence and documentation.

**Michigan Department of Environmental Quality, May 2009.** Pre-CERCLIS Screening Work Plan for Atlas Powder Senter, Michigan. May 2009.

**Weston Solutions, Inc. 2006.** WESTON START III Generic Quality Assurance Project Plan (QAPP).

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## TABLES

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**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	tar1	tar2	mag-pile1	mag-pile2	mag-pile3	mag-pile2b	mag-pile4	mag-pile5	Part 201 SDBL	Part 201 RDCC
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-1	XRF-2	XRF-3	XRF-4	XRF-5	XRF-6	XRF-7	XRF-8		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			
<b>Metals</b>											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<b>27</b>	<LOD	<LOD	<b>467</b>	<LOD	<b>241</b>	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	76	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	590	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	542	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	161	84	<LOD	509	<LOD	122	<LOD	<LOD	32	<b>20,000</b>
Iron	mg/kg	3,874	7,629	8,792	60,120	2,459	20,899	5,843	2,597	12,000	<b>160,000</b>
Lead	mg/kg	376	<b>804</b>	126	<b>10,815</b>	142	<b>2,588</b>	<b>1,053</b>	126	21	<b>400</b>
Manganese	mg/kg	<LOD	514	874	616	201	1,256	468	583	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	21	<LOD	<LOD	<LOD	16	23	<LOD	16	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	20	45	28	39	29	42	60	41	NA	<b>330,000</b>
Zinc	mg/kg	296	582	202	1,762	282	896	465	801	47	<b>170,000</b>

**NOTES:**

Bolded results exceed the Part 201 Residential Direct Contact Criteria.

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	mag-pile6	mag-pile7	mag-pile8	mag-pile9	mag-pile10	mag-pile11	mag-pile12	mag-pile13	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-9	XRF-10	XRF-11	XRF-12	XRF-13	XRF-14	XRF-15	XRF-16		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	80	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	<LOD	32	<LOD	<LOD	27	24	166	79	32	<b>20,000</b>
Iron	mg/kg	1,448	4,515	2,388	3,386	3,703	4,051	13,261	6,122	12,000	<b>160,000</b>
Lead	mg/kg	20	276	96	198	157	190	<b>1,242</b>	<b>546</b>	21	<b>400</b>
Manganese	mg/kg	550	153	165	254	126	97	726	170	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	9	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	37	39	32	47	34	43	89	53	NA	<b>330,000</b>
Zinc	mg/kg	355	375	230	249	86	568	5,315	815	47	<b>170,000</b>

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	mag-pile14	mag-pile15	mag-pile16	mag-pile17	mag-pile18	mag-pile19	mag-pile20	mag-pile21	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-17	XRF-18	XRF-19	XRF-20	XRF-21	XRF-22	XRF-23	XRF-24		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Antimony	mg/kg	<LOD	<LOD	<LOD	315	<LOD	<LOD	<LOD	<LOD	NA	180
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	7.6
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	550
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	790,000
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	2,600
Copper	mg/kg	27	<LOD	<LOD	142	<LOD	<LOD	25	<LOD	32	20,000
Iron	mg/kg	2,695	2,709	1,704	16,679	1,504	1,716	4,500	756	12,000	160,000
Lead	mg/kg	24	63	15	1,607	167	50	78	<LOD	21	400
Manganese	mg/kg	124	<LOD	126	252	114	187	<LOD	571	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	<LOD	9	12	<LOD	<LOD	11	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	2,500
Strontium	mg/kg	30	39	28	72	25	31	25	19	NA	330,000
Zinc	mg/kg	60	53	54	1,498	390	221	99	68	47	170,000

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	mag-pile22	mag-pile23	mag-pile24	ap-01	ap-02	ap-03	ap-04	ap05	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-25	XRF-26	XRF-27	XRF-49	XRF-48	XRF-47	XRF-31	XRF-32		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	180
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	309	6	7.6
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	550
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	790,000
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	2,600
Copper	mg/kg	49	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	95	32	20,000
Iron	mg/kg	42,919	9,628	6,570	876	275	565	1,440	9,157	12,000	160,000
Lead	mg/kg	445	530	302	65	<LOD	8	15	12,676	21	400
Manganese	mg/kg	590	1,359	723	486	110	180	1,984	694	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	13	18	<LOD	13	17	<LOD	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	2,500
Strontium	mg/kg	23	32	34	28	12	16	22	94	NA	330,000
Zinc	mg/kg	515	315	278	305	55	72	108	5,213	47	170,000

NOTES:

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined



**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

	Sample Name	ap05-b	ap-06	ap-07	ap-08	ap-09	ap-10	ap-11	ap-12	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-33	XRF-34	XRF-35	XRF-36	XRF-37	XRF-38	XRF-43	XRF-42		
Parameter	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Antimony	mg/kg	<LOD	69	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	180
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	7.6
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	550
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	790,000
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	607	<LOD	<LOD	<LOD	7	2,600
Copper	mg/kg	76	<LOD	<LOD	<LOD	51	<LOD	<LOD	<LOD	32	20,000
Iron	mg/kg	6,561	5,734	1,924	3,169	34,249	1,115	2,845	3,379	12,000	160,000
Lead	mg/kg	12,071	694	22	17	961	<LOD	13	19	21	400
Manganese	mg/kg	858	1,992	86	<LOD	382	1,077	1,291	2,139	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	11	<LOD	<LOD	16	10	<LOD	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	2,500
Strontium	mg/kg	82	48	21	27	80	25	36	35	NA	330,000
Zinc	mg/kg	4,772	2,506	190	51	1,007	90	52	62	47	170,000

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	ap-13	ap-14	ap-15	ap-16	ap-17	ap-18	ap-19	ap-20	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-41	XRF-52	XRF-51	XRF-50	XRF-40	XRF-39	XRF-53	XRF-54		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	72	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	32	<b>20,000</b>
Iron	mg/kg	7,037	1,217	367	1,744	734	630	2,914	1,075	12,000	<b>160,000</b>
Lead	mg/kg	101	14	12	38	25	<LOD	<LOD	9	21	<b>400</b>
Manganese	mg/kg	823	162	<LOD	483	397	1,206	644	1,235	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	<LOD	<LOD	12	12	19	11	<LOD	19	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	39	20	16	24	22	20	26	20	NA	<b>330,000</b>
Zinc	mg/kg	314	137	108	127	77	47	19	71	47	<b>170,000</b>

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

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Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	ap-21	ap-22	ap-23	ap-24	ap-25	ap-26	ap-27	ap-28	ap-29	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-55	XRF-44	XRF-45	XRF-46	XRF-56	XRF-62	XRF-76	XRF-74	XRF-75		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>												
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	66	65	<LOD	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<b>81</b>	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	<LOD	<LOD	<LOD	51	<LOD	<LOD	<LOD	<LOD	40	32	<b>20,000</b>
Iron	mg/kg	1,544	1,836	855	4,536	1,117	1,489	9,896	4,131	8,517	12,000	<b>160,000</b>
Lead	mg/kg	28	31	11	<b>987</b>	78	8	101	260	<b>1,312</b>	21	<b>400</b>
Manganese	mg/kg	469	1,432	850	314	655	1,427	292	476	146	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	46	0.13	<b>160</b>
Molybdenum	mg/kg	14	13	20	<LOD	23	18	<LOD	<LOD	<LOD	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	25	29	27	31	36	23	43	37	81	NA	<b>330,000</b>
Zinc	mg/kg	79	288	160	231	475	70	102	398	405	47	<b>170,000</b>

NOTES:

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Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	ap-30	ap-31	ap-32	ap-33	ap-34	ap-35	ap-36	ap-37	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-57	XRF-58	XRF-71	XRF-63	XRF-61	XRF-60	XRF-59	XRF-73		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	91	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	31	49	157	<LOD	<LOD	<LOD	<LOD	56	32	<b>20,000</b>
Iron	mg/kg	8,551	6,884	15,524	2,376	910	2,591	2,370	5,138	12,000	<b>160,000</b>
Lead	mg/kg	258	266	<b>3,056</b>	12	<LOD	207	168	<b>413</b>	21	<b>400</b>
Manganese	mg/kg	116	241	231	630	153	248	<LOD	<LOD	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	<LOD	<LOD	<LOD	10	16	11	11	<LOD	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	60	53	51	27	19	43	34	37	NA	<b>330,000</b>
Zinc	mg/kg	273	275	1,118	70	114	390	263	481	47	<b>170,000</b>

NOTES:

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

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Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

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**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	ap-38	ap-39	ap-40	ap-41	ap-42	ap-43	ap-44	ap-45	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/29/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-72	XRF-64	XRF-77	XRF-78	XRF-79	XRF-80	XRF-83	XRF-86		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	180
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	7.6
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	550
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	790,000
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	2,600
Copper	mg/kg	177	86	36	60	<LOD	<LOD	<LOD	78	32	20,000
Iron	mg/kg	12,720	52,290	6,471	6,495	5,532	1,146	3,181	9,336	12,000	160,000
Lead	mg/kg	885	701	242	1,010	129	20	41	715	21	400
Manganese	mg/kg	244	<LOD	<LOD	125	128	116	174	249	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	17	<LOD	10	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	2,500
Strontium	mg/kg	80	45	55	44	32	19	35	47	NA	330,000
Zinc	mg/kg	1,022	791	504	389	338	85	199	673	47	170,000

NOTES:

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

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Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	ap-46	ap-47	ap-48	ap-49	ap-50	ap-51	ap-52	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-82	XRF-65	XRF-67	XRF-84	XRF-85	XRF-88	XRF-89		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>										
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	88	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	61	<LOD	69	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	41	44	<LOD	<LOD	<LOD	<LOD	<LOD	32	<b>20,000</b>
Iron	mg/kg	2,961	14,585	1,697	6,813	6,233	9,316	1,239	12,000	<b>160,000</b>
Lead	mg/kg	79	80	15	21	39	12	16	21	<b>400</b>
Manganese	mg/kg	309	115	121	103	176	<LOD	121	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	30	27	28	43	35	46	25	NA	<b>330,000</b>
Zinc	mg/kg	151	552	17	55	60	31	80	47	<b>170,000</b>

NOTES:

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

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**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	aw1	aw2	aw3	magpile25	mapile26	magpile27	magpile28	magpile29	MAG-PILE30	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/28/2009	7/29/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-28	XRF-29	XRF-30	XRF-66	XRF-81	XRF-68	XRF-69	XRF-70	XRF-87		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals												
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	68	<LOD	<LOD	NA	180
Arsenic	mg/kg	<LOD	8	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	7.6
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	550
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	790,000
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	2,600
Copper	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	175	116	54	<LOD	32	20,000
Iron	mg/kg	3,532	2,323	2,860	3,194	5,979	35,440	6,994	6,660	4,529	12,000	160,000
Lead	mg/kg	12	9	9	24	58	1,357	777	573	<LOD	21	400
Manganese	mg/kg	158	1,277	302	164	270	<LOD	112	316	107	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	17	<LOD	9	<LOD	<LOD	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	2,500
Strontium	mg/kg	45	30	31	32	22	39	33	53	40	NA	330,000
Zinc	mg/kg	31	74	25	113	174	776	702	425	37	47	170,000

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	MAG-PILE31	MAG-PILE32	MAG-PILE34	SANDPIT-1	SANDPIT-2	ROAD-1	ROAD-2	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-90	XRF-91	XRF-92	XRF-93	XRF-94	XRF-95	XRF-108		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>										
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	<LOD	53	70	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	32	<b>20,000</b>
Iron	mg/kg	4,431	3,909	2,474	3,957	3,629	5,652	4,324	12,000	<b>160,000</b>
Lead	mg/kg	10	<LOD	98	<LOD	41	<LOD	<LOD	21	<b>400</b>
Manganese	mg/kg	201	101	<LOD	<LOD	174	171	264	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	37	32	39	41	48	35	38	NA	<b>330,000</b>
Zinc	mg/kg	105	29	431	16	58	43	52	47	<b>170,000</b>

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined



**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	ROAD-3	ROAD-4	ROAD-5	ROAD-6	ROAD-7	ROAD-8	ROAD-9	ROAD-10	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-109	XRF-110	XRF-111	XRF-112	XRF-113	XRF-99	XRF-100	XRF-101		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	<LOD	<LOD	68	<LOD	<LOD	<LOD	<LOD	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	27	<LOD	<LOD	32	<b>20,000</b>
Iron	mg/kg	6,737	5,511	4,002	5,245	5,535	6,170	5,133	5,950	12,000	<b>160,000</b>
Lead	mg/kg	11	<LOD	<LOD	<LOD	18	29	17	12	21	<b>400</b>
Manganese	mg/kg	<LOD	<LOD	210	132	129	138	217	<LOD	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	40	36	39	39	35	36	46	49	NA	<b>330,000</b>
Zinc	mg/kg	28	32	82	55	71	49	133	43	47	<b>170,000</b>

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	ROAD-11	ROAD-12	ROAD-13	ROAD-14	ROAD-15	ROAD-16	ROAD-17	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-114	XRF-115	XRF-116	XRF-103	XRF-104	XRF-96	XRF-97		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
<b>Metals</b>										
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	<b>180</b>
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	<b>7.6</b>
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	67	1	<b>550</b>
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	<b>790,000</b>
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	<b>2,600</b>
Copper	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	32	<b>20,000</b>
Iron	mg/kg	4,788	8,842	5,003	5,220	4,757	5,132	6,455	12,000	<b>160,000</b>
Lead	mg/kg	<LOD	16	<LOD	<LOD	<LOD	<LOD	<LOD	21	<b>400</b>
Manganese	mg/kg	120	<LOD	114	434	357	510	342	440	<b>25,000</b>
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	<b>160</b>
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	<b>2,600</b>
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	<b>4,000</b>
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	<b>2,600</b>
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	<b>2,500</b>
Strontium	mg/kg	37	45	31	38	38	33	38	NA	<b>330,000</b>
Zinc	mg/kg	28	23	20	24	28	21	26	47	<b>170,000</b>

**NOTES:**

Bolded results exceed the Part 201 Residential Direct Contact Criteria.

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 1**  
**SUMMARY OF XRF SCREENING RESULTS - JULY 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	WETLAND-1	WETLAND-2	WETLAND-3	WETLAND-4	WETLAND-5	MOUND-1	AW-4	PAINT_CANS-1	Part 201 SDBL	Part 201 SDBL
	Sample Date	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009	7/29/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	XRF-98	XRF-117	XRF-118	XRF-119	XRF-106	XRF-102	XRF-105	XRF-107		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Antimony	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	180
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6	7.6
Cadmium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	72	1	550
Chromium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	18	790,000
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	7	2,600
Copper	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	32	20,000
Iron	mg/kg	1,114	3,397	3,014	1,199	1,669	2,380	1,711	11,871	12,000	160,000
Lead	mg/kg	<LOD	<LOD	<LOD	9	<LOD	<LOD	<LOD	56	21	400
Manganese	mg/kg	255	3,383	5,059	6,058	1,042	<LOD	381	1,480	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	72	<LOD	<LOD	<LOD	<LOD	20	4,000
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Silver	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1	2,500
Strontium	mg/kg	10	24	21	18	17	27	29	46	NA	330,000
Zinc	mg/kg	10	108	207	568	61	<LOD	32	80	47	170,000

NOTES:

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

**TABLE 2**  
**SUMMARY OF XRF SCREENING RESULTS - SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENTER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	XRF-2	XRF-3	XRF-4	XRF-5	XRF-6	XRF-7	XRF-8	XRF-9	Part 201 SDBL	Part 201 RDCC
	Sample Date	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	TT-6	TT-6	TT-6	TT-6	TT-6	TT-7	TT-7	TT-7		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Arsenic	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	841	29	<LOD	5.8	7.6
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	1,436	<LOD	<LOD	6.8	2,600
Copper	mg/kg	123	38	99	102	38	927	36	42.80	32	20,000
Iron	mg/kg	4,656	3,098	18,170	15,356	3,279	307,072	6,062	5,228	12,000	160,000
Lead	mg/kg	190	23	344	362	23	10,709	385	1,020	21	400
Manganese	mg/kg	83	< 69.92	737	612	714	3,291	111	2,005	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	8	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Rubidium	mg/kg	29	26	24	26.40	21	22	36	24	NA	NA
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Strontium	mg/kg	49	30	37	42	38	56	49	63	NA	330,000
Thallium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	35
Tungsten	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	NA
Uranium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	NA
Zinc	mg/kg	98	36	882	855	218	56,711	894	833	47	170,000
Zircon	mg/kg	69	97	71	69	73	29	77	70	NA	NA

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

TT - Test Trench

**TABLE 2**  
**SUMMARY OF XRF SCREENING RESULTS - SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	XRF-10	XRF-11	XRF-12	XRF-13	XRF-14	XRF-15	XRF-16	XRF-17	Part 201 SDBL	Part 201 RDCC
	Sample Date	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	TT-7	TT-8	TT-8	TT-8	TT-8	TT-5	TT-5	TT-5		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Arsenic	mg/kg	<LOD	<LOD	13	<LOD	53	15	<LOD	< 27.52	5.8	7.6
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	126	<LOD	<LOD	<LOD	6.8	2,600
Copper	mg/kg	<LOD	42	123	<LOD	84	<LOD	<LOD	110	32	20,000
Iron	mg/kg	3,894	5,770	3,522	3,892	11,021	3,787	5,853	92,011	12,000	160,000
Lead	mg/kg	135	27	61	<LOD	668	42	<LOD	234	21	400
Manganese	mg/kg	105	214	<LOD	<LOD	841	<LOD	123	628	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	14	<LOD	<LOD	<LOD	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Rubidium	mg/kg	27	29	17	25	15	30	35	28	NA	NA
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Strontium	mg/kg	36	43	40	39	34	35	42	45	NA	330,000
Thallium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	35
Tungsten	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	NA
Uranium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	NA
Zinc	mg/kg	68	37	247	<LOD	672	21	<LOD	6,896	47	170,000
Zircon	mg/kg	132	112	79	70	49	184	145	61	NA	NA

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

TT - Test Trench

**TABLE 2**  
**SUMMARY OF XRF SCREENING RESULTS - SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	XRF-18	XRF-19	XRF-20	XRF-21	XRF-22	XRF-23	XRF-24	XRF-25	Part 201 SDBL	Part 201 RDCC
	Sample Date	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009	9/16/2009		
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
	Sample Location	TT-4	TT-4	TT-2	TT-2	TT-2	TT-3	TT-3	TT-1		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Metals											
Arsenic	mg/kg	<LOD	113	<LOD	<LOD	65	<LOD	<LOD	<LOD	5.8	7.6
Cobalt	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	6.8	2,600
Copper	mg/kg	288	274	446	290	228	176	2,201	124	32	20,000
Iron	mg/kg	531,671	21,791	22,248	13,862	81,028	12,722	9,906	12,323	12,000	160,000
Lead	mg/kg	794	1,419	1,881	501	566	2,950	766	1,438	21	400
Manganese	mg/kg	<LOD	828	626	242	264	354	112	304	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	20	4,000
Rubidium	mg/kg	<LOD	30	33	21	33	29	14	32	NA	NA
Selenium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.41	2,600
Strontium	mg/kg	17	114	61	66	54	73	56	131	NA	330,000
Thallium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	35
Tungsten	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	NA
Uranium	mg/kg	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	NA	NA
Zinc	mg/kg	<LOD	1,053	1,394	452	170	928	144	274	47	170,000
Zircon	mg/kg	29	124	117	75	90	102	160	149	NA	NA

**NOTES:**

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

TT - Test Trench

**TABLE 2**  
**SUMMARY OF XRF SCREENING RESULTS - SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	XRF-26	XRF-27	XRF-28	Part 201 SDBL	Part 201 RDCC
	Sample Date	9/16/2009	9/16/2009	9/16/2009		
	Sample Matrix	Soil	Soil	Soil		
	Sample Location	TT-1	TT-1	TT-1		
	Units	mg/kg	mg/kg	mg/kg		
Metals						
Arsenic	mg/kg	<LOD	77	92	5.8	7.6
Cobalt	mg/kg	<LOD	<LOD	<LOD	6.8	2,600
Copper	mg/kg	30	367	419	32	20,000
Iron	mg/kg	8,952	22,954	71,356	12,000	160,000
Lead	mg/kg	21	1,017	1,136	21	400
Manganese	mg/kg	136	500	746	440	25,000
Mercury	mg/kg	<LOD	<LOD	<LOD	0.13	160
Molybdenum	mg/kg	<LOD	<LOD	11	NA	2,600
Nickel	mg/kg	<LOD	<LOD	<LOD	20	4,000
Rubidium	mg/kg	34	26	33	NA	NA
Selenium	mg/kg	<LOD	<LOD	<LOD	0.41	2,600
Strontium	mg/kg	83	57	80	NA	330,000
Thallium	mg/kg	<LOD	<LOD	<LOD	NA	35
Tungsten	mg/kg	<LOD	<LOD	<LOD	NA	NA
Uranium	mg/kg	<LOD	<LOD	<LOD	NA	NA
Zinc	mg/kg	279	834	1,113	47	170,000
Zircon	mg/kg	143	114	109	NA	NA

NOTES:

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

<LOD - less than method limit of detection of XRF instrument

Part 201-SDBL - MDEQ Part 201 Statewide Default Background Level

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

NA - Not applicable or not determined

TT - Test Trench

**TABLE 3**  
**ANALYTICAL RESULTS OF RESIDENTIAL WELL AND SURFACE WATER SAMPLES - JULY/SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES SA**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

All sample results in µg/l (ppb).

Well addresses are all on E. Grosse Pointe Shores (EGPS)

Well Address Date Sampled	MCL/AL	Lowest Part 201 Criteria	Reporting Limit	27031 EGPS 7/29/2009	27005 EGPS 7/29/2009	26967 EGPS 7/29/2009	26961 EGPS 7/30/2009	26929 EGPS 7/29/2009	26921 EGPS 7/29/2009
<b>General Chemistry</b>									
Chloride		<b>250,000</b>	4,000	ND	ND	9,000	13,000	5,000	ND
Fluoride	<b>4,000</b>		100	ND	100	ND	ND	ND	ND
Hardness			10,000	75,000	84,000	57,000	63,000	72,000	218,000
Iron		<b>2,000 / 300</b>	100	ND	200	ND	ND	ND	200
Nitrate	<b>10,000</b>		400	ND	ND	ND	ND	ND	4,500
Nitrite	<b>1,000</b>		50	ND	ND	ND	ND	ND	ND
Sodium		<b>120,000</b>	5,000	ND	11,000	5,000	5,000	ND	34,000
Sulfate		<b>250,000</b>	5,000	ND	62,000	ND	5,000	17,000	168,000
<b>Volatile Organics</b>									
All Results were Non-detect									
<b>Semi-volatile Organics</b>									
Di(2-ethylhexyl)phthalate	<b>6</b>	<b>6</b>	0.6	ND	ND	ND	ND	ND	2
<b>Metals</b>									
Aluminum		<b>50</b>	50	ND	ND	ND	ND	ND	ND
Arsenic	<b>10</b>	<b>10</b>	2	ND	ND	ND	ND	ND	ND
Barium	<b>2,000</b>	<b>2,000</b>	10	20	130	10	20	20	30
Cadmium	<b>5</b>	<b>5</b>	0.3	ND	ND	ND	ND	ND	ND
Chromium	<b>100</b>	<b>11</b>	10	ND	ND	ND	ND	ND	ND
Copper	<b>1,300</b>	<b>1,000</b>	50	ND	ND	ND	ND	ND	ND
Iron		<b>2,000 / 300</b>	20	120	<b>2,250</b>	110	180	130	<b>590</b>
Lead	<b>15</b>	<b>4</b>	1	2	ND	ND	ND	ND	ND
Manganese		<b>860 / 50</b>	10	ND	<b>70</b>	ND	ND	ND	20
Mercury	<b>2</b>	<b>0.0013</b>	0.1	ND	ND	ND	ND	ND	ND
Selenium	<b>50</b>	<b>5</b>	1	ND	ND	ND	ND	ND	ND
Zinc		<b>2,400</b>	10	110	ND	ND	110	170	10

Notes:

Bolded Results Exceed Criteria

\* Sample SW1 EPGS was a surface water sample and is not compared to groundwater criteria



**TABLE 3**  
**ANALYTICAL RESULTS OF RESIDENTIAL WELL AND SURFACE WATER SAMPLES - JULY/SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES SA**  
**SETER, HOUGHTON COUNTY, MICHIGAN**

All sample results in µg/l (ppb).

Well addresses are all on E. Grosse Pointe Shores (EGPS)

Well Address Date Sampled	MCL/AL	Lowest Part 201 Criteria	Reporting Limit	26921 EGPS 9/16/2009	Artesian Spring 7/29/2009	26769 EGPS 9/16/2009	26711 EGPS 9/16/2009	26687 EGPS 8/7/2009	26603 EGPS 9/17/2009
<b>General Chemistry</b>									
Chloride		<b>250,000</b>	4,000	ND	ND	10,000	7,000	7,000	9,000
Fluoride	<b>4,000</b>		100	ND	ND	ND	100	100	100
Hardness			10,000	233,000	59,000	181,000	75,000	107,000	122,000
Iron		<b>2,000 / 300</b>	100	200	ND	ND	ND	ND	ND
Nitrate	<b>10,000</b>		400	4,700	ND	3,000	ND	900	1,400
Nitrite	<b>1,000</b>		50	ND	ND	ND	ND	ND	ND
Sodium		<b>120,000</b>	5,000	35,000	8,000	25,000	12,000	17,000	20,000
Sulfate		<b>250,000</b>	5,000	183,000	28,000	137,000	35,000	70,000	81,000
<b>Volatile Organics</b>									
All Results were Non-detect									
<b>Semi-volatile Organics</b>									
Di(2-ethylhexyl)phthalate	<b>6</b>	<b>6</b>	0.6	0.8	ND	ND	2	NA	ND
<b>Metals</b>									
Aluminum		<b>50</b>	50	ND	<b>120</b>	ND	ND	NA	ND
Arsenic	<b>10</b>	<b>10</b>	2	ND	ND	ND	ND	NA	2
Barium	<b>2,000</b>	<b>2,000</b>	10	40	10	100	120	NA	100
Cadmium	<b>5</b>	<b>5</b>	0.3	ND	ND	ND	ND	NA	ND
Chromium	<b>100</b>	<b>11</b>	10	ND	ND	ND	ND	NA	ND
Copper	<b>1,300</b>	<b>1,000</b>	50	ND	ND	ND	ND	NA	ND
Iron		<b>2,000 / 300</b>	20	<b>550</b>	220	230	150	NA	150
Lead	<b>15</b>	<b>4</b>	1	ND	ND	ND	ND	NA	ND
Manganese		<b>860 / 50</b>	10	10	30	ND	10	NA	ND
Mercury	<b>2</b>	<b>0.0013</b>	0.1	ND	ND	ND	ND	NA	ND
Selenium	<b>50</b>	<b>5</b>	1	ND	ND	ND	ND	NA	ND
Zinc		<b>2,400</b>	10	10	ND	40	ND	NA	30

Notes:

Bolded Results Exceed Criteria

\* Sample SW1 EPGS was a surface water sample and is not compared to gr

**TABLE 3**  
**ANALYTICAL RESULTS OF RESIDENTIAL WELL AND SURFACE WATER SAMPLES - JULY/SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES SA**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

All sample results in µg/l (ppb).

Well addresses are all on E. Grosse Pointe Shores (EGPS)

Well Address Date Sampled	MCL/AL	Lowest Part 201 Criteria	Reporting Limit	26381 EGPS 8/3/2009	26359 EGPS 7/29/2009	26298 EGPS 9/16/2009	26207 EGPS 9/16/2009	26187 EGPS 9/16/2009	26147 EGPS 9/16/2009	SW1 EGPS* 9/17/2009
<b>General Chemistry</b>										
Chloride		<b>250,000</b>	4,000	4,000	ND	ND	10,000	ND	9,000	ND
Fluoride	<b>4,000</b>		100	ND	ND	100	200	200	200	ND
Hardness			10,000	205,000	36,000	46,000	48,000	91,000	74,000	185,000
Iron		<b>2,000 / 300</b>	100	ND	<b>8,000</b>	ND	ND	ND	ND	1,100
Nitrate	<b>10,000</b>		400	<b>10,200</b>	ND	ND	ND	2,800	1,600	ND
Nitrite	<b>1,000</b>		50	ND	ND	ND	ND	ND	ND	ND
Sodium		<b>120,000</b>	5,000	23,000	ND	16,000	22,000	10,000	20,000	81,000
Sulfate		<b>250,000</b>	5,000	108,000	6,000	7,000	8,000	22,000	18,000	225,000
<b>Volatile Organics</b>										
All Results were Non-detect										
<b>Semi-volatile Organics</b>										
Di(2-ethylhexyl)phthalate	<b>6</b>	<b>6</b>	0.6	NA	ND	ND	ND	0.7	0.7	0.6
<b>Metals</b>										
Aluminum		<b>50</b>	50	NA	ND	ND	ND	ND	ND	70
Arsenic	<b>10</b>	<b>10</b>	2	NA	ND	3	ND	2	2	ND
Barium	<b>2,000</b>	<b>2,000</b>	10	NA	30	220	190	150	120	80
Cadmium	<b>5</b>	<b>5</b>	0.3	NA	ND	ND	ND	ND	ND	ND
Chromium	<b>100</b>	<b>11</b>	10	NA	ND	ND	ND	ND	ND	ND
Copper	<b>1,300</b>	<b>1,000</b>	50	NA	ND	ND	ND	ND	ND	ND
Iron		<b>2,000 / 300</b>	20	NA	<b>6,880</b>	40	90	160	70	1,660
Lead	<b>15</b>	<b>4</b>	1	NA	ND	1	ND	ND	ND	ND
Manganese		<b>860 / 50</b>	10	NA	<b>80</b>	ND	ND	ND	ND	240
Mercury	<b>2</b>	<b>0.0013</b>	0.1	NA	ND	ND	ND	ND	ND	ND
Selenium	<b>50</b>	<b>5</b>	1	NA	ND	1	1	ND	ND	ND
Zinc		<b>2,400</b>	10	NA	ND	ND	ND	90	ND	10

Notes:

Bolded Results Exceed Criteria

\* Sample SW1 EPGS was a surface water sample and is not compared to gr

**TABLE 4**  
**ANALYTICAL RESULTS OF SURFACE SOIL SAMPLES - SEPTEMBER 2009**  
**ATLAS POWDER EXPLOSIVES**  
**SENER, HOUGHTON COUNTY, MICHIGAN**

Parameter	Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	Part 201 RDCC
	Sample Date	9/17/2009	9/17/2009	9/17/2009	9/17/2009	9/17/2009	
	Sample Matrix	Soil	Soil	Soil	Soil	Soil	
	Sample Location	Surface Soil	Surface Soil	Surface Soil	Surface Soil	Surface Soil	
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
<b>Metals</b>							
Aluminum	mg/kg	5,700	2,600	470	5,800	960	<b>50,000</b>
Arsenic	mg/kg	<b>16</b>	6.2	1.0	7.6	0.66	<b>7.6</b>
Barium	mg/kg	1,500	230	67	300	63	<b>37,000</b>
Cadmium	mg/kg	6.2	1.8	0.44	1.1	0.2	<b>5,500</b>
Chromium	mg/kg	37	97	3.0	18	2.5	<b>2,500</b>
Copper	mg/kg	390	120	25	440	6.9	<b>20,000</b>
Iron	mg/kg	28,000	37,000	3,200	35,000	2,800	<b>160,000</b>
Lead	mg/kg	<b>16,000</b>	<b>2,200</b>	360	<b>4,500</b>	37	<b>400</b>
Lead - Coarse	mg/kg	<b>29,000</b>	<b>1,200</b>	<b>400</b>	<b>46,000</b>	52	<b>400</b>
Lead - Fine	mg/kg	<b>29,000</b>	<b>6,100</b>	<b>600</b>	<b>8,500</b>	77	<b>400</b>
Lead - Total (calc.)	mg/kg	<b>29,000</b>	<b>2,700</b>	<b>460</b>	<b>34,000</b>	59	<b>400</b>
Manganese	mg/kg	ND	210	150	610	310	<b>25,000</b>
Mercury	mg/kg	ND	0.72	0.10	0.24	0.11	<b>160</b>
Selenium	mg/kg	ND	0.63	0.58	0.61	0.62	<b>2,600</b>
Zinc	mg/kg	110	420	180	1,400	65	<b>170,000</b>

NOTES:

**Bolded results exceed the Part 201 Residential Direct Contact Criteria.**

Part 201-RDCC - MDEQ Part 201 Residential Direct Contact Criteria

mg/kg - Milligrams per kilogram

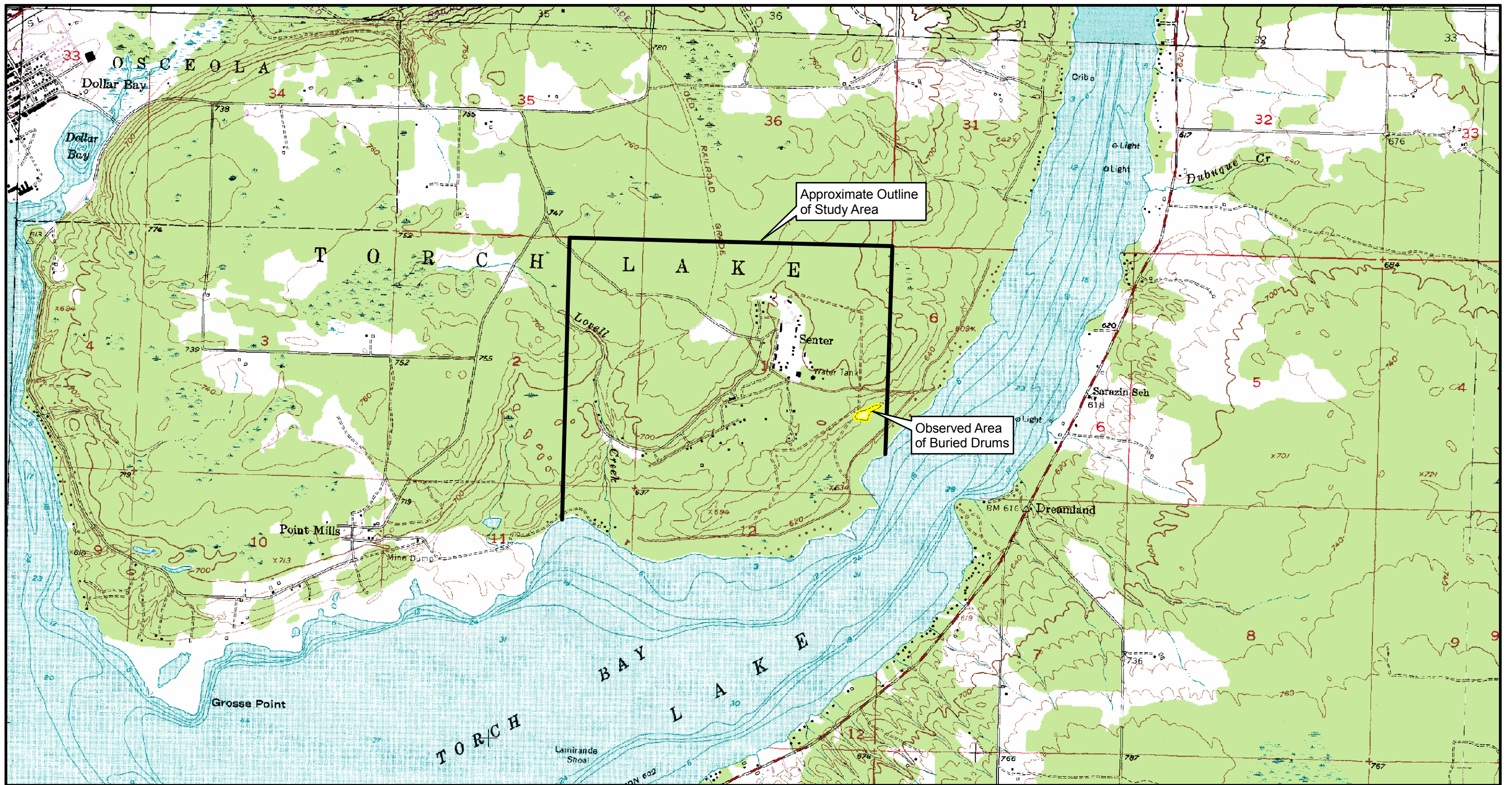
ND - Not detected at method limit of detection

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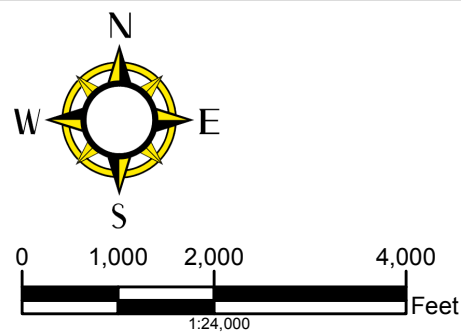
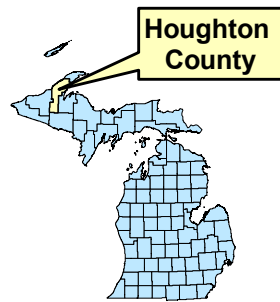
## FIGURES

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Base Map Source: Michigan Geographic Data Library, HOUGHTON\_n\_drg24k



**Figure: 1**



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04



Prepared by:  
**WESTON SOLUTIONS, INC.**  
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Okemos, Michigan

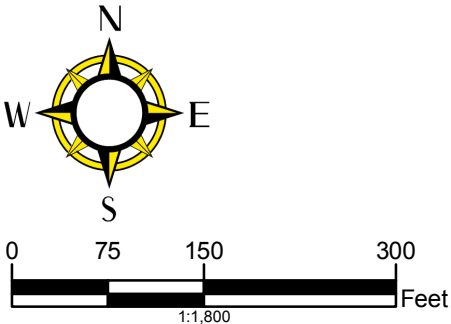
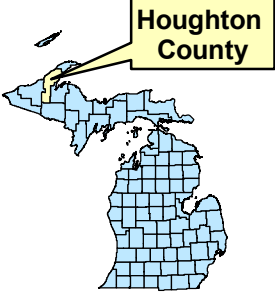
**SITE LOCATION MAP**

ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN





Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)



- Legend**
- OBSERVED AREA OF BURIED DEBRIS
  - GPS FEATURE (15 JUNE 2009)



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ

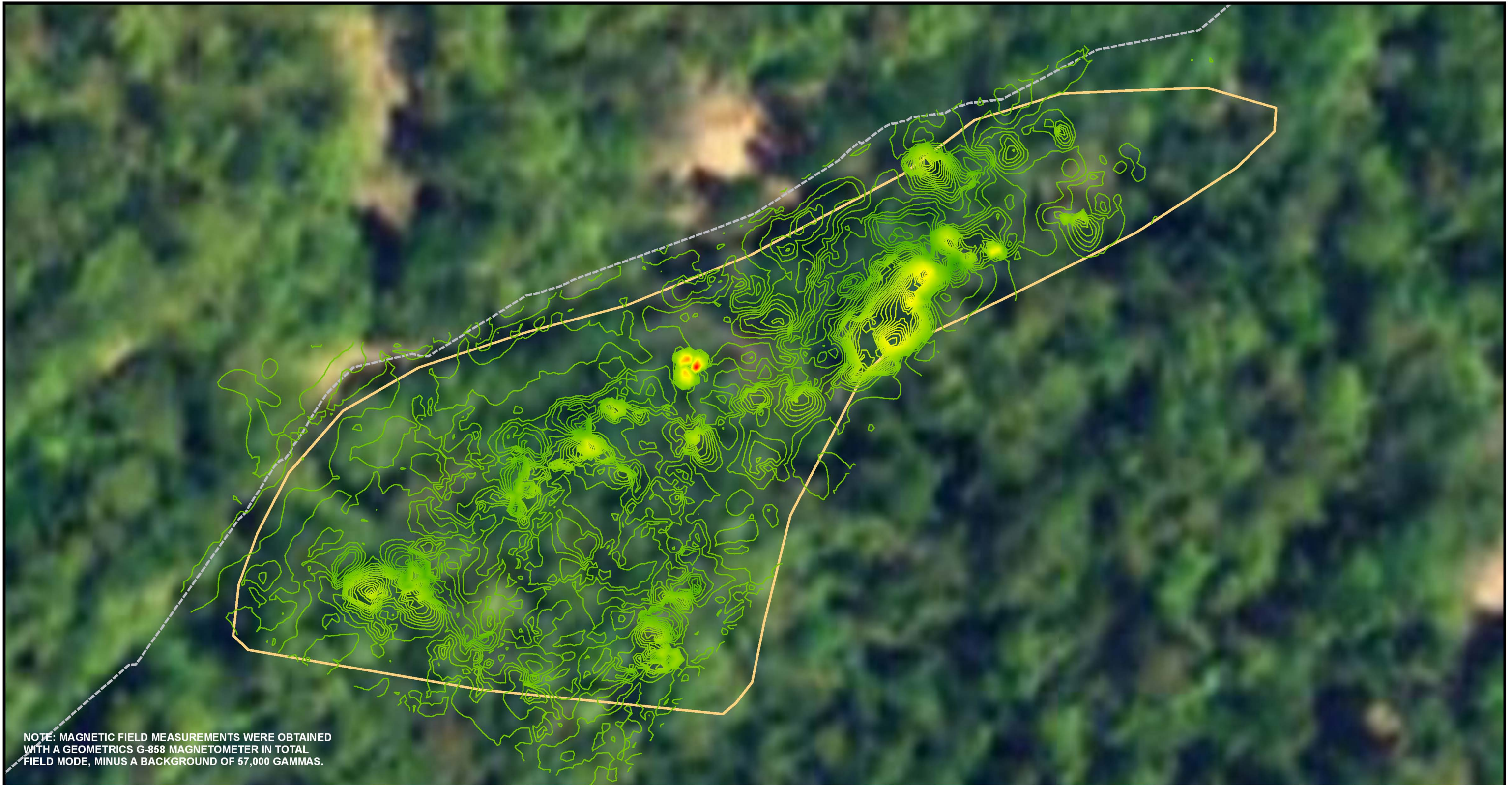


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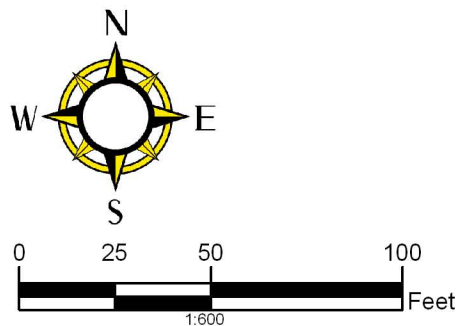
**SITE RECONNAISSANCE MAP**  
  
ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN

**Figure: 2**





NOTE: MAGNETIC FIELD MEASUREMENTS WERE OBTAINED WITH A GEOMETRICS G-858 MAGNETOMETER IN TOTAL FIELD MODE, MINUS A BACKGROUND OF 57,000 GAMMAS.



- Legend**
- MAGNETIC FIELD CONTOURS (GAMMAS)
    - 1200 (green line)
    - 5800 (red line)
  - TWO-TRACK ROAD (dashed white line)
  - OBSERVED AREA OF BURIED DEBRIS (orange outline)

Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)

**Figure: 3**



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



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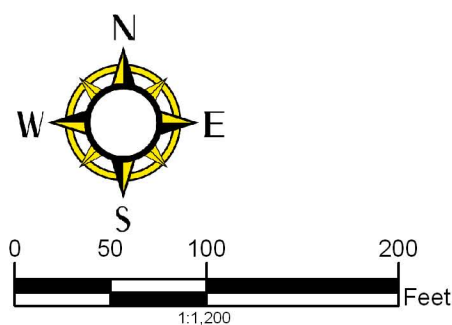
**PASSIVE MAGNETIC FIELD SURVEY - JULY 2009**

ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN





Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)



#### Legend

- DEBRIS LOCATION
- + BROADER DEBRIS AREA
- TWO-TRACK ROAD
- OBSERVED AREA OF BURIED DEBRIS



Prepared for:  
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Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



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#### SUMMARY OF DEBRIS SURVEY - JULY 2009

ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN

**Figure: 4**

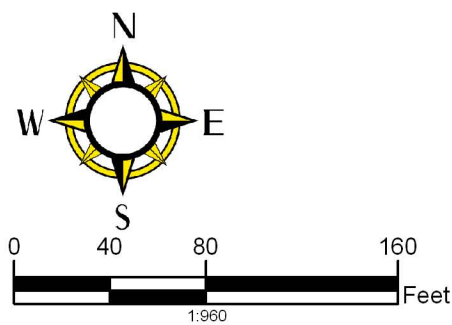








Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)



#### Legend

- XRF SAMPLE LOCATIONS
- TWO-TRACK ROAD
- OBSERVED AREA OF BURIED DEBRIS



Prepared for:  
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Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



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#### XRF SAMPLE LOCATIONS - JULY 2009

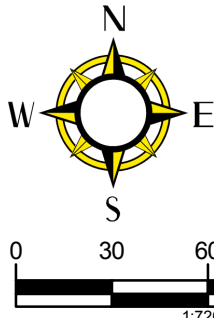
ATLAS POWDER EXPLOSIVES SA  
SETER, HOUGHTON COUNTY, MICHIGAN

**Figure: 6**





Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)



- Legend**
- TEST TRENCH LOCATION
  - TWO-TRACK ROAD
  - OBSERVED AREA OF BURIED DEBRIS



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



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2501 Jolly Road, Suite 100  
Okemos, Michigan

**TEST TRENCH LOCATIONS -  
SEPTEMBER 2009**

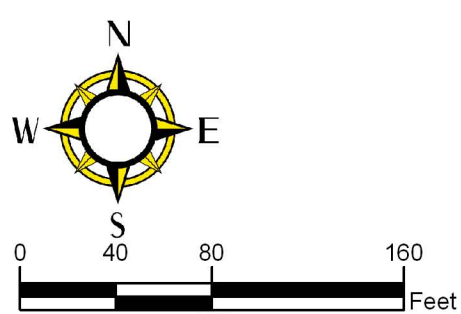
ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN

**Figure: 7**





Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)



**Legend**

ARSENIC (PPM)

- NON-DETECTABLE CONCENTRATIONS
- LESS THAN MDEQ PART 201 RDCC
- GREATER THAN MDEQ PART 201 RDCC
- ESTIMATED AREA OF ARSENIC IMPACT

NOTE: RDCC= RESIDENTIAL AND COMMERCIAL I DIRECT CONTACT CRITERIA.



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



Prepared by:  
**WESTON SOLUTIONS, INC.**  
2501 Jolly Road, Suite 100  
Okemos, Michigan

**XRF ARSENIC RESULTS GREATER THAN CRITERIA - JULY 2009**

ATLAS POWDER EXPLOSIVES SA  
SENTER, HOUGHTON COUNTY, MICHIGAN

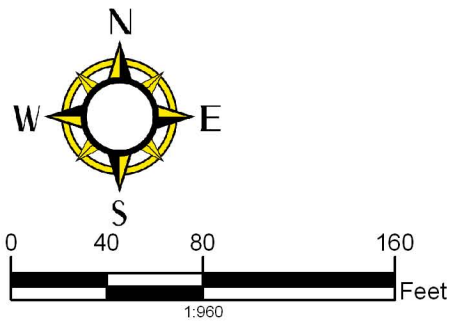
**Figure: 8**





Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)

Figure: 9



**Legend**

LEAD (PPM)

- NON-DETECTABLE CONCENTRATIONS
- LESS THAN MDEQ PART 201 RDCC
- GREATER THAN MDEQ PART 201 RDCC
- ESTIMATED AREA OF LEAD IMPACT

NOTE: RDCC= RESIDENTIAL AND COMMERCIAL I DIRECT CONTACT CRITERIA.



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



Prepared by:  
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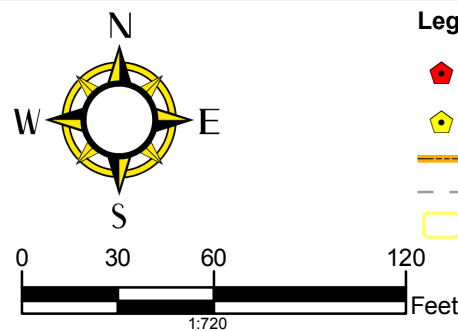
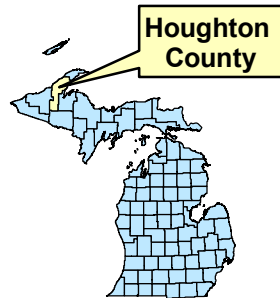
**XRF LEAD RESULTS GREATER THAN CRITERIA - JULY 2009**

ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN





EAST GROSSE POINTE SHORES RD



- Legend**
- XRF SAMPLE LOCATION (9/16/09) WITH RESULTS GREATER THAN PART 201 RESIDENTIAL DIRECT CONTACT CRITERIA
  - XRF SAMPLE LOCATION (9/16/09) WITH RESULTS LESS THAN PART 201 RESIDENTIAL DIRECT CONTACT CRITERIA
  - TEST TRENCH LOCATION
  - TWO-TRACK ROAD
  - OBSERVED AREA OF BURIED DEBRIS

Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)

Figure: 10



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ

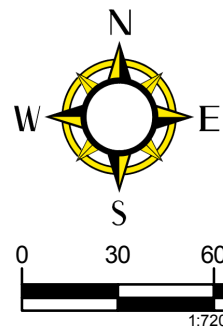
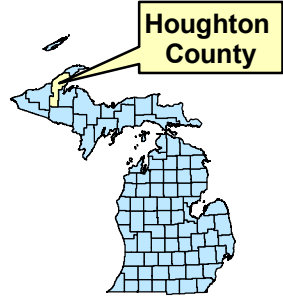


Prepared by:  
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Okemos, Michigan

**TEST TRENCH XRF RESULTS GREATER THAN CRITERIA - SEPTEMBER 2009**

ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN





- Legend**
- SURFACE SOIL SAMPLE LOCATION (9/17/09) WITH RESULTS GREATER THAN PART 201 RESIDENTIAL DIRECT CONTACT CRITERIA
  - SURFACE SOIL SAMPLE LOCATION (9/17/09) WITH RESULTS LESS THAN PART 201 RESIDENTIAL DIRECT CONTACT CRITERIA
  - TWO-TRACK ROAD
  - OBSERVED AREA OF BURIED DEBRIS

Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)

Figure: 11



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



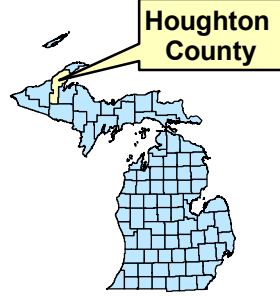
Prepared by:  
**WESTON SOLUTIONS, INC.**  
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Okemos, Michigan

**SOIL SAMPLE LOCATIONS AND RESULTS  
GREATER THAN CRITERIA - SEPT. 2009**

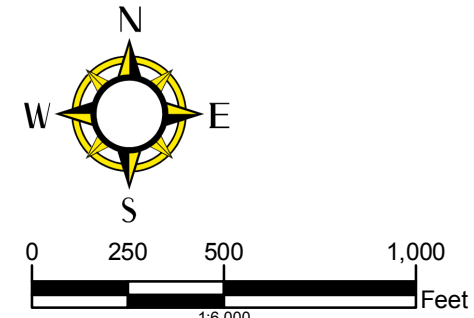
ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN







**Houghton County**




0 250 500 1,000 Feet  
1:6,000

**Legend**


- RESIDENTIAL WELL SAMPLE LOCATION WITH RESULTS GREATER THAN PART 201 CRITERIA OR MCL/AL
- RESIDENTIAL WELL SAMPLE LOCATION WITH RESULTS LESS THAN PART 201 CRITERIA OR MCL/AL
- SURFACE WATER SAMPLE LOCATION
- DITCH
- TWO-TRACK ROAD
- OBSERVED AREA OF BURIED DEBRIS

Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ

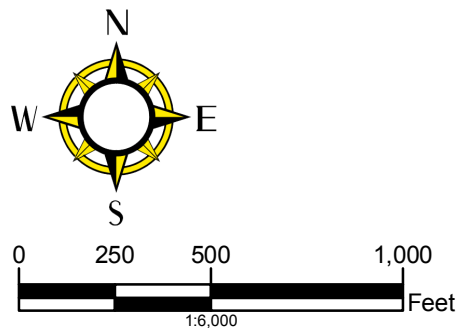
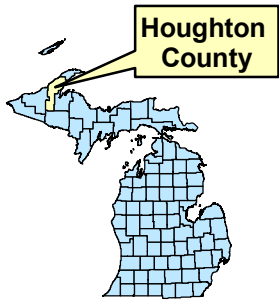


Prepared by:  
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**RESIDENTIAL WELLS AND SURFACE WATER  
SAMPLE LOCATIONS AND RESULTS -  
JULY - SEPTEMBER 2009**  
ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN

**Figure: 12**





**Legend**

- RESIDENTIAL WELL SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION
- DITCH
- TWO-TRACK ROAD
- OBSERVED AREA OF BURIED DEBRIS

Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)

**Figure: 13**



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



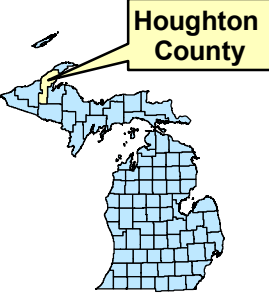
Prepared by:  
**WESTON SOLUTIONS, INC.**  
2501 Jolly Road, Suite 100  
Okemos, Michigan

**SULFATE RESULTS - RESIDENTIAL WELLS  
AND SURFACE WATER - SEPTEMBER 2009**

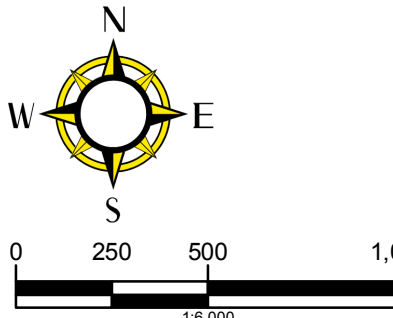
ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN







**Houghton County**




0 250 500 1,000 Feet  
1:6,000

**Legend**


- RESIDENTIAL WELL SAMPLE LOCATION WITH NITRATE RESULTS GREATER THAN MCL/AL
- RESIDENTIAL WELL SAMPLE LOCATION WITH NITRATE RESULTS LESS THAN MCL/AL
- SURFACE WATER SAMPLE LOCATION
- DITCH
- TWO-TRACK ROAD
- OBSERVED AREA OF BURIED DEBRIS

Source of Aerial Photograph: ESRI World Imagery Map Service (NAIP 2005-06-21)



Prepared for:  
**U.S. EPA REGION V**  
Contract No: EP-S5-06-04

TDD No.: S05-0001-0811-010  
DCN: 567-2A-AFSJ



Prepared by:  
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**NITRATE RESULTS - RESIDENTIAL WELLS AND SURFACE WATER - SEPTEMBER 2009**

ATLAS POWDER EXPLOSIVES SA  
SENER, HOUGHTON COUNTY, MICHIGAN

**Figure: 14**



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**ATTACHMENT A**  
**TITLE SEARCH INFORMATION**

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**ATTACHMENT B**  
**EPIC AERIAL PHOTOGRAPHS**

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**ATTACHMENT C**  
**PHOTOGRAPHIC LOG**

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