Health Consultation – Steel Slag on County Roads, Muscatine County, Iowa

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Background and Statement of Issues

The following health consultation has been prepared to evaluate the potential adverse health impacts of steel slag applied upon county roads in Muscatine County, Iowa. The steel slag utilized in Muscatine County is a by-product from the SSAB (Svenskt Stål Aktiebolag) steel mill located near Montpelier, Iowa. This steel slag is screened to an appropriate size to be used by Muscatine County as substitute for Class A Road Rock. Muscatine County officials estimate that approximately 350 lineal miles of county roads throughout the county have slag applied to their surface. The largest amount of slag applied to county roads was in 2015-2017. Smaller amounts of slag were placed on the county roads in 2018 since the use was suspended in June of 2018.

The health concerns expressed by residents in Muscatine County come from the chemical constituents found in the steel slag applied to the county roads. This health consultation will be reviewing the levels of a select list of chemical constituents found within slag applied to select locations of the county roads. This health consultation will utilize standard exposure assessment methodology and toxicological information to determine if the levels of these chemicals within the slag applied to county roads has the potential to cause adverse health impacts to people living near the roads where the slag is applied. This health consultation will be evaluating the following exposure scenarios:

- Exposure to children living near and routinely traveling on roads where slag is applied.
- Exposure to adults living near and routinely traveling on roads where slag is applied.
- Incidental ingestion and inhalation exposure to the slag applied to the roads are considered in each of these exposure scenarios for children and adults living near and routinely traveling on roads where slag has been applied.
- Exposure to workers who apply slag and maintain the roads where slag is applied.

Assumptions Used in Health Consultation

There are several assumptions used in the development of this health consultation. These assumptions are important to note up front. These assumptions directly affect the conclusions of this health consultation.

The first assumption relates to amount of slag from the roads that children and adults might be exposed. Children and adults are exposed to substances in the environment through what is called, “incidental ingestion”. Incidental ingestion is the amount of soil and dust a person can ingest through normal living activities through hand-to-mouth and object-to-mouth activities, and through soil and dust that adheres to food. A person’s total amount of soil and dust that it incidentally ingested comes from soil and dust in areas that they live, work, and play – essentially from all locations they come in contact.

The U.S. Environmental Protection Agency (EPA) provides incidental ingestion exposure factors for both children and adults. In the development of these exposure factors the EPA has looked at a variety of studies that attempt to determine incidental ingestion by a variety of methodologies.

One methodology, called the Tracer Methodology, attempts to quantify the amounts of soil ingested by analyzing samples of soil and dust from residences and/or children's play areas, and feces or urine. A second methodology, called the the Biokinetic Model, compares direct measurements of a biomarker, such as blood or urine levels of a toxicant, with predictions from a biokinetic model of oral, dermal, and inhalation exposure routes with air, food, water, soil, and dust toxicant sources. A third methodology, the Activity Pattern Methodology, combines information on hand-to-mouth and object-to-mouth activities and time spent at various locations. In all of these methodologies, it is assumed that a person's incidental exposure to soil and dust comes from soil and dust at the location where they live. Further information on these methodologies are found at the following web link: https://www.epa.gov/sites/production/files/2018-01/documents/efh-chapter05_2017.pdf

Sources of incidental ingestion of soil and dust near the sampling locations included in this health consultation include a variety of locations, the road location being one of many locations. This health consultation is assuming that 50 percent of total soil and dust incidental ingestion for a person living in areas where slag has been applied to county roads comes from the actual slag placed on county roads. This assumption is more than adequate to account for the potential health impacts from incidental ingestion of slag residue. As a result, the incidental ingestion exposure factors utilized in this health consultation for exposure to slag deposited on county roads will be 50 percent of the EPA exposure factors to account for exposure to slag from the county roads.

The second assumption relates to the bioavailability of the metal constituents within the slag deposited on the county roads. Bioavailability is the availability of a substance to be distributed to tissues and cells within the body once that substance is absorbed into the body. This health consultation will assume 100 percent relative bioavailability of metals within the slag. That is, the amount of metal absorbed from the slag is the same as the exposure matrix used to establish the health effect levels utilized in this health consultation.

Sampling of Select Section of County Roads where Slag Applied

The Iowa Department of Natural Resources (IDNR) worked closely with the Muscatine County Engineers office to select locations of county roads where slag had been applied. Muscatine County officials provided a county road map and information on the amounts of slag material used per street route and date of application. The IDNR selected the locations for sampling based on:

- Amount of slag applied per route
- The date of application - locations where slag was recently applied
- Locations in close vicinity to residential properties

Based upon information supplied from Muscatine County, the IDNR selected the following list of rural streets for sampling and shown in Table 1. Twenty surface samples from each road were collected at each of the locations shown in Table 1. Eleven samples were collected from 131st

Street (sample location # 10) for background analysis where no slag had been applied. Two samples, one from each side of the road, were collected on the roadway just south 1333 Holly Avenue after IDNR was alerted to what appeared to be high slag application rates.

Results of County Road Sampling

Tables and figures included at the end of this health consultation show the results of the analysis of the slag samples from the selected road locations. IDNR's X-ray fluorescence (XRF) spectrometer was to analyze the samples collected from the road locations. The IDNR used an Olympus Vanta XRF. A portion of the road stone/slag sample was sieved through a # 10 screen and bagged in a Whirlpac© and screened on the instrument in the IDNR's lab. In addition to the use of the XRF, select samples were also sent to the State Hygienic Laboratory at the University of Iowa (SHL) for analysis. The purpose of the SHL analyses was to confirm and calibrate the readings obtained by the XRF and to provide a baseline of the concentrations of constituents found within the slag samples. Tables 2 through Table 22 contain the results from the laboratory analysis completed by SHL. Slag samples from the Holly Avenue location were screened to analyze finely sized materials (125 microns to 63 microns and a size less than 63 microns). The screen sizes, #125 mesh and #230 mesh, were the two screens available to the IDNR and the #230 mesh may be about the smallest practical size for dry sieving the material. These screened samples were analyzed by SHL and the results of these analyses are contained in Tables 23 through 26. The analytical reports from the SHL are included in Appendix A.

Figures 1 through 5 are the statistical analysis of the XRF readings completed by the IDNR. During the initial phases of the Muscatine County Steel Slag road sampling, it became apparent that there were discrepancies between the observed XRF screening result and the confirmation lab results obtained for manganese (Mn) concentration any given sample. In an attempt to define the relationship between the SHL results and the XRF screening results, seven samples at each location were selected for basic statistical analysis by the IDNR shown in Figures 1 through 5.

The manganese concentration from the SHL laboratory analysis was divided by the XRF screening concentration for each of the seven samples. Those seven ratios were then selected for basic statistical analysis. The statistical mean, and upper and lower 95% confidence boundaries were then determined for each location. It was obvious that, due to the matrix of the steel slag, the XRF quantified about half of the Mn concentrations reported by the lab. The XRF is not sufficiently reliable enough to quantify Mn concentrations on its own, but combined with analytical laboratory results can provide a reliable screening method.

For site locations #1 (Davis Avenue) and #5 (260th Street), all 20 soil samples collected from each location were XRF screened and those results were statistically analyzed. For site location #2 (Trolley Avenue), 13 samples were XRF screened and for site location #3 (Independence Avenue), 15 samples were XRF screened. (Both site #2 and #3 exhibited relatively low XRF screened values for Mn.) The upper 95% Mn concentration was selected from each site location and multiplied by the upper 95% confidence boundary (2.278) of the SHL to XRF ratio. This mathematical operation will yield the upper 90% confidence boundary for the corrected

concentration of Mn at that given site location. (See attached Site Corrected Values. Stats Doc Site # 1, Site #2, Site #3, and Site #5 shown as Figures 1 through 5).

A "background" site (no slag applied) was selected for sampling and is noted as Site #10 on 131st Street. Eleven samples were collected, 5 from each side of the 100-foot section of road – and a field duplicate. All 11 samples were XRF screened and five samples were submitted for laboratory analysis. It was evident that the XRF was able to more accurately quantify the Mn concentration in the limestone matrix.

A section of Holly Avenue was observed to have an obviously heavy application of steel slag. At this location, a grab sample was collected from each side of the road (noted on the SHL analytical results in Appendix A as1333 Holly-E and 1333 Holly-W). Both samples were XRF screened and a sample of each was submitted for laboratory analysis. Each sample was sieved by the Iowa DNR into two classes of fines from each sample location. These four sieved samples are note as E-1, E-2 W-1, and W-2. Samples E-1 and W-1 consisted of material less than 125 microns in size and greater than 63 microns. Samples E-2 and W-2 consisted of material of 63 microns and less. All 4 of the sieved samples were submitted for laboratory analysis of manganese, vanadium, cadmium and arsenic. Since samples were only collected from two locations at the Holly Avenue address, no statistical analysis was performed for the sieved samples.

ATSDR Comparison Values and Iowa Statewide Standards

An evaluation on the health significance of the concentrations of the metals that are within the slag that has been applied to the county roads is completed in this health consultation. The first step in this evaluation will be to make a comparison between the concentrations of metals within the material on the road to published screening levels from both the Agency for Toxic Substances and Disease Registry (ATSDR) and the Iowa Department of Natural Resources. For the purposes of this health consultation we are using the comparison values for soil, since the potential for exposure to slag deposits on roads will be similar to the potential for exposure to soil in the environment.

The ATSDR Comparison Values are levels of substances found within soil, water, or air that according to the latest toxicological studies are well below levels not expected to cause adverse health impacts. Further information regarding the ATSDR Comparison Values is at the following web link: https://www.atsdr.cdc.gov/sites/brownfields/CVViewer.html. The ATSDR Comparison Values have been determined for acute, intermediate, and chronic exposures. ATSDR defines acute exposure as an exposure lasting from 1 to 14 days. ATSDR defines intermediate exposure as an exposure lasting from 14 days to 1 year. ATSDR defines chronic exposure as an exposure lasting from 1 year to a lifetime. Table 27 is a list of ATSDR Comparison Values for the metals found in soil that were included in the laboratory analyses.

The Iowa Department of Natural Resources has developed Iowa Statewide Standards for soil. According to the Iowa Department of Natural Resources a statewide standard represents "a

concentration of a contaminant in a specific media of an affected area at which normal, unrestricted exposure through a specific exposure pathway is considered unlikely to pose a threat to human health, safety, or the environment." Table 28 is a list of the Iowa Statewide Standards for soil for the metals found in soil that were included in the laboratory analyses.

As can be seen from the concentrations shown in Table 27 and Table 28, there are some difference between these levels. The reason for the difference is the assumptions and degree of protectiveness assumed in the development of the ATSDR Comparison Values and the Iowa Statewide Standards.

Table 29 is the lowest comparison value for metals within soil between either the ATSDR Comparison Values or the Iowa Statewide Standards. The concentration of the metals within the slag on the county roads are compared to the levels shown in Table 29. If the concentration of the metals within the slag is at or below the ATSDR Comparison Values and the Iowa Statewide Standards, represented by the levels in Table 29, then we can assume that these levels of metals will not cause adverse health impacts to people exposed to the slag in the areas sampled. This would include all individuals including children, elderly, and other sensitive portions of the population. If the concentration of the metals within the slag is above either the ATSDR Comparison Values or the Iowa Statewide Standards then further toxicological evaluation is needed to determine if adverse health impacts might occur from exposure to the slag on the road.

Table 30 is a listing of the concentrations of metals, as determined by the SHL analyses, within the slag deposited on the roads that are above the ATSDR Comparison Values and the Iowa Statewide Standards. The table shows the location of the slag, the metal within the slag, the concentration that is above the ATSDR Comparison Values and Iowa Statewide Standard, the exposure frequency of the comparison value, and the person who may be at risk from the slag exposure.

As seen in Table 30 the concentration of the following metals within the slag are above the ATSDR Comparison Values and the Iowa Statewide Standards.

- Arsenic
- Cadmium
- Manganese
- Vanadium

Exposure to these metals near each road section are evaluated in this health consultation. All other substances detected within the slag samples, but not above comparison values, will not need to be evaluated for potential health impacts since the levels of exposure are below that which would adversely affect human health.

At each of the 20 locations of each road section sampled, with the exception of Holly Avenue, the XRF was used to determine the concentration of manganese. A correlation factor was able to be determined from comparing the XRF reading and the SHL sample results. This correlation factor was then used to determine the true concentration of manganese for the XRF. Since a multitude of XRF readings were obtained at each road section a determination of the statistical

upper bound average exposure level could be determined for manganese at each section of road. A summary of these statistical calculations was included in Figures 1 through 5. The upper-bound average level of manganese at each road section is included in Table 31.

This health consultation will evaluate the potential for adverse health impacts from exposure near each of the road sections where sampling was completed. Table 32 includes the concentrations of metals above comparison values within road sections used for this health consultation. The upper bound average for manganese that was able to be determined for the Davis Avenue, Trolley Avenue, Independence Avenue, and 260th Street locations is the level used for evaluation in this health consultation. Since the upper bound average was not able to be determined along Holly Avenue, the highest level of manganese found along Holly Avenue is the level used for evaluation in this health consultation.

Slag Exposure to County Maintenance Workers

The potential for adverse health impacts to county road maintenance workers who apply and maintain the slag that is applied to roads can be assessed by comparing the highest concentration of metals found within the slag shown in Table 32 to the acute comparison value within the ATSDR Comparison Values (Table 27). Maintenance workers are not routinely exposed to slag, but only when they haul, spread, and maintain the slag roads. These are short-term events, only several days at a time, and would most closely align with the definition of an acute exposure. The highest levels of metals within the road samples are all below the ATSDR Comparison Values for short-term or acute exposure. Because of this, it is concluded that county road maintenance workers will not experience adverse health impacts from exposure to the metals found within the slag.

Exposure Assessment for People Living Near Roads Covered with Slag

The following sections of this health consultation have been prepared as an exposure assessment of slag deposited on county roads in Muscatine County for individuals living near these roads. It will be limited to exposure to arsenic, cadmium, manganese, and vanadium within the slag – those metals found within the slag at concentrations above the ATSDR Comparison Values and the Iowa Statewide Standards. Therefore, each section of county road is evaluated using the levels of metals shown in Table 32.

There are three major ways that humans are exposed to chemicals within the environment – ingestion, inhalation, and absorption through the skin. Due to the protective layers within skin it is unlikely that any appreciable amount of metals found within the slag will be absorbed through the skin. However, an estimate needs to be made of the amount of slag particles that could be ingested or inhaled by people living near the areas where the slag has been deposited. After this exposure estimation is made, a thorough review will be completed of toxicological studies that will enable a determination to be made if this estimated exposure (ingestion and inhalation) to

slag particles could adversely impact the health of people living near roads where the slag has been applied.

Incidental Exposure to Soil and Dust

A determination of the amount of slag material a person is exposed through the ingestion route is made in this health consultation. The US EPA has prepared an exposure factors handbook which includes estimates of the levels of human exposure to substances in the environment. An update to the EPA Exposure Factors Handbook was completed in September 2017 for Soil and Dust Ingestion. This update can be found at the following link: https://www.epa.gov/sites/production/files/2018-01/documents/efh-chapter05_2017.pdf The referenced Exposure Factors Handbook has the following recommended upper percentile values for soil and dust ingestion:

- Children – 200 mg/day
- Pica Child – 1000 mg/day
- Adults – 100 mg/day

These exposure factors consider exposure to all sources of soil and dust and would include locations of exposure to soil and dust in areas where adults and children live, work, and frequent on a regular basis. This includes soil and dust from all areas of exposure, not just from dust from roads that have been covered with slag. A person's exposure to soil and dust could occur from many places: areas of employment, home locations including yards and gardens, shopping locations and other locations a person visits. For the purposes of this health consultation a conservative assumption has been made that 50 percent of an adult and child's overall soil and dust exposure will come from the slag that is deposited on county roads.

A general definition of the concept of pica is that of ingesting nonfood substances, or ingesting large quantities of certain particular foods. The prevalence of pica is difficult to establish because of differences in definition and the reluctance of patients to admit to abnormal cravings and ingestion. An incidence of pica greater than 50% is considered normal in children aged 18 to 36 months. Pica is thought to decrease with age; one study showed that about 10% of children older than 12 years engage in pica. Soil pica is the recurrent ingestion of unusually high amounts of soil. Some children experience this condition and can consume up to 1000 mg/day of soil. This high exposure to soils will only be possible for a child that routinely plays in soil and exhibits this type of behavior.

With the above considerations, it is proposed that the following ingestion rates be utilized for exposure to slag deposited on the county roads.

- Children Exposed to Slag – 100 mg/day
- Pica Child Exposed to Slag – 1,000 mg/day (only if slag is deposited within play areas)
- Adults Exposed to Slag – 50 mg/day

The slag ingestion exposure levels shown above is the total amount of slag that an individual may be exposed living near the roads where slag is deposited. This health consultation will

evaluate the potential health impacts for exposure to each individual metal found within the slag at these rates of exposure.

Tables 33 through 38 have been prepared that indicates the dose level for various individuals at the concentration of metals found with the slag deposited on the various section of county roads. The dose level is estimated daily exposure level per body weight of the individual exposed. This health consultation includes the standard body weight assumptions of 15 kg for children and 80 kg for adults. The dose levels in the tables below will be the dose level used to evaluate the potential of adverse health impacts for exposure to metals contained within the slag deposited on the roads. This health consultation assumes that all of the metals found within the steel slag is bioavailable and will be absorbed into blood stream and distributed throughout the body. This bioavailability is assumed since a sufficient number of studies determining the bioavailability of metals within steel slag is not available. The following is a sample calculation for one of the dose levels in the Tables 33 through 38:

Incidental Ingestion of Manganese for Child Living Near Davis Avenue Location:

$$\frac{14{,}137 \text{ mg Mn}}{\text{kg soil}} \times \frac{100 \text{ mg soil}}{\text{day}} \times \frac{\text{kg soil}}{1{,}000{,}000 \text{ mg soil}} \times \frac{}{15 \text{ kg body weight}}$$

= 0.094 mg/kg/day

Inhalation of Slag Particles

In order to determine a level or dust that individuals living near areas where the slag has been deposited on county roads we need to know how much dust is generated by traffic on the roads in Muscatine County that have been covered with slag. The IDNR has created a tool (macro-embedded spreadsheet) used to predict particulate concentrations caused by emissions from unpaved roads – the Unpaved Road PM10 Predictor. The tool is specific to the county location and utilizes weather data from that county. This tool allows for the determination of the concentration of PM-10 particles that will be generated by traffic on the county roads. PM-10 is defined as small particulate matter within air that is below 10 microns in size. Particles that are smaller than 10 microns in size have the potential of being inhaled directly into the lungs and would have the potential to impact human health. Inputs to this model include the number of vehicles per day, the percent silt content of the road, the mean vehicle speed, and the distance of the road to the point of exposure. With the input from the Muscatine County Engineer and some reasonable assumptions, the following inputs to the model were used:

- Vehicles per day – 45
- Silt content of the slag – 6.4 percent
- Mean vehicle speed – 40 miles per hour

- Exposure distance from road – 50 feet

The tool predicted a 24-hour level of 114 ug/m^3 (micrograms per cubic meter) for PM-10 particles. A screen shot of the output from this spreadsheet is included in Appendix B. This is the PM-10 level for slag particles. A determination needs to be made of the PM-10 level for each individual metal found within the slag particles. The highest concentration of metals shown in Table 32 are used for this determination. The estimated PM-10 level for each metal are calculated as follows:

PM-10 level for slag (114 ug/m^3) x Metal Concentration / 1,000,000 (conversion between mg and kg). The following is the estimated PM-10 level for each of the metals detected in the slag.

- Arsenic 0.00048 ug/m^3 or 0.00000048 mg/m^3
- Cadmium 0.0016 ug/m^3 or 0.0000016 mg/m^3
- Manganese 2.2 ug/m^3 or 0.0022 mg/m^3
- Vanadium 0.039 ug/m^3 or 0.000039 mg/m^3

Review of Toxicological Studies – Ingestion

The following portion of this health consultation is a summary of a review of the Toxicological Profiles that are prepared by the Agency for Toxic Substances and Disease Registry. These profiles contain recent animal studies and human epidemiological studies of exposure to substances. The lowest level of adverse human health impacts from exposure to chemicals can be found within these profiles. These levels will be used to assist in the determination if exposure to slag is likely to cause adverse health impacts in children and adults. In this section of this health consultation the toxicological profiles will be reviewed for information on ingestions exposure.

Arsenic

The Toxicological Profile for Arsenic is available online at the following link:

https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=22&tid=3

According to the Toxicological Profile for Arsenic the lowest observed adverse health effect level (LOAEL) found in human studies involving long term or chronic ingestion exposure is a dose of 0.014 mg/kg/day. At this level of chronic exposure the adverse health effects that have been observed are: hyperkeratosis and hyperpigmentation (skin thickening and discoloration). This is also the lowest level of exposure where cancer impacts (basal cell and squamous cell carcinomas of the skin, and hemangioendothelioma of the liver) have been observed after many years of exposure.

All the dose levels for ingestion exposure in Tables 33 through 38 are below the LOAEL of 0.014 mg/kg/day. Because of this, it can be concluded that the concentration of arsenic within the slag deposited on the roads will not adversely impact human health for both children and adults through the ingestion route.

Cadmium

The Toxicological Profile for Cadmium is available online at the following link:

https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=48&tid=15

According to the Toxicological Profile for Cadmium the LOAEL found in human studies involving chronic ingestion exposure is a dose of 0.0078 mg/kg/day. At this level of chronic exposure the adverse health effect that was observed is a kidney impact of increase excretion of low molecular weight proteins. Cancer impacts were observed in animal studies, but at a much higher dose of 3.5 mg/kg/day.

All the dose levels for ingestion exposure in Tables 33 through 38 are below the LOAEL of 0.0078 mg/kg/day. Because of this, it can be concluded that the concentration of cadmium within the slag deposited on the roads will not adversely impact human health for both children and adults through the ingestion route.

Manganese

The Toxicological Profile for Manganese is available online at the following link:

https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=102&tid=23

According to the Toxicological Profile for Manganese the LOAEL found in human studies involving chronic ingestion exposure is a dose of 0.06 mg/kg/day. At this level of chronic exposure the adverse health effects observed included significantly reduced performance on IQ tests, and some lowering of verbal and visual memory and learning skills. There is no evidence of manganese causing cancer in animals or humans.

Exposure to manganese and lead can have additive neurological impacts when exposure to these substances occur at the same time. The level of lead found within the slag is very low and so no additive neurological impacts will result from exposure to manganese and lead contained within the slag. Children who have with elevated blood lead levels and have been diagnosed as lead-poisoned, may have a potential for aggregated neurological health impacts from exposure to the manganese found in the slag. These concerns need to be considered on an individual basis for locations where slag has been applied to roads.

Manganese is also an essential nutrient and the Food and Nutrition Board of the Institute of Medicine has set adequate intake (AI) levels for manganese for children and adults. The AI of manganese for children 1 to 3 years of age is 1.2 mg/day. The AI for children expressed as a dose would be 1.2 mg/day / 15 kg or 0.08 mg/kg/day. The AI of manganese for an adult is 2.2 mg/day and is recognized that a daily amount of up to 10 mg/day would be safe for adults. The daily amount of 10 mg/day for an adult expressed as a dose would be 0.14 mg/kg/day. ADSTR has recommended an interim guidance value of 0.16 mg manganese/kg/day, based on the Tolerable Upper Intake Level (UL) for adults of 11 mg manganese/day.

Taking all of the toxicological information available for manganese together, we can assume that receiving doses from incidental ingestion higher that 0.08 mg/kg/day for children and 0.14

mg/kg/day for adults may have the possibility of causing adverse health impacts. Table 39 contains information on the road section locations and exposure scenarios that may be of health concern due to manganese exposure above a LOAEL.

Children living near the locations on Davis Avenue, 260th Street, and Holly Avenue may be receiving more manganese than their bodies can utilize and as a result may experience some adverse health impacts – those impacts would be impacts that could affect learning and IQ.

Children who exhibit pica behavior (direct ingestion of soil) will most likely experience adverse health impacts from slag at all locations where slag is applied. But, these children would need to be playing regularly in slag deposit areas – such as a driveway that has been covered with slag.

Vanadium

The Toxicological Profile for Vanadium is available online at the following link:

https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=276&tid=50

The Toxicological Profile for Vanadium has very limited information on human exposure studies. The toxicological profile has information that is limited to intermediate time frame human exposures studies. The no observed adverse effect level (NOAEL) for vanadium is a dose of 0.12 mg/kg/day. This is a dose where no adverse health impacts have been observed during a 12 week exposure time and would be considered to be a safe exposure level.

All the dose levels for ingestion exposure for vanadium are below the NOAEL of 0.12 mg/kg/day in Tables 33 through 38. Because of this, it can be concluded that the concentration of vanadium within the slag deposited on the roads will not adversely impact human health for both children and adults through the ingestion route.

Review of Toxicological Studies – Inhalation

In this section of the health consultation profiles will be reviewed for information on inhalation exposure.

Arsenic

According to the Toxicological Profile for Arsenic the LOAEL found in human studies involving chronic inhalation exposure is exposure to an arsenic concentration of 0.078 mg/m^3. At this level of chronic exposure the adverse health effects that were observed are mild pigmentation and keratosis (warts or calluses) of skin.

The estimated PM-10 level for arsenic from road traffic exposure of 0.0000004 mg/m^3 is much lower that the LOAEL of 0.078 mg/m^3. Because of this, it can be concluded that the amount of arsenic inhaled by both children and adults from road dust will not adversely impact human health.

Cadmium

According to the Toxicological Profile for Cadmium the LOAEL found in human studies involving chronic inhalation exposure is exposure to a cadmium concentration of 0.023 mg/m^3. At this level of chronic exposure the adverse health effects that were observed are the presence of abnormal quantities of protein in urine.

The estimated PM-10 level for cadmium from road traffic exposure of 0.0000016 mg/m^3 is much lower that the LOAEL of 0.023 mg/m^3. Because of this it can be concluded that the amount of cadmium inhaled by both children and adults from road dust will not adversely impact human health.

Manganese

According to the Toxicological Profile for Manganese the LOAEL found in human studies involving chronic inhalation exposure is exposure to a manganese concentration of 0.032 mg/m^3. At this level of chronic exposure the adverse health effects that were observed were a decrease in motor functions.

The estimated PM-10 level for manganese from road traffic exposure of 0.0022 mg/m^3 is lower than the LOAEL of 0.032 mg/m^3. Because of this it can be concluded that the amount of manganese inhaled by both children and adults from road dust will not adversely impact human health.

Vanadium

The Toxicological Profile for Vanadium has very limited information on human chronic inhalation exposure studies. According to the Toxicological Profile for Vanadium the LOAEL found in animal studies involving chronic inhalation exposure is exposure to a manganese concentration of 0.28 mg/m3. At this level of chronic exposure the adverse health effects that were observed were hyperplasia (increase in production) in the some cells of the respiratory track.

The estimated PM-10 level for vanadium from road traffic exposure of 0.000039 mg/m^3 is much lower than the LOAEL of 0.032 mg/m^3. Because of this, it can be concluded that the amount of manganese inhaled by both children and adults from road dust will not adversely impact human health.

Conclusions

This health consultation has evaluated the potential for adverse health impacts to humans from exposure to steel slag applied to county roads in Muscatine County, Iowa. An evaluation of incidental ingestion and inhalation exposure to both children and adults living near the roads where the sampling was completed. In addition, an evaluation was completed of exposure to workers who apply slag and maintain the roads where steel slag is applied. Table 40 is a

summary of the conclusions reached by this health consultation and indicates the potential for adverse health impacts at each road location evaluated.

Summary:

- Children and adults living near the sample locations along Trolley Avenue and Independence Avenue are not at risk of adverse health impacts from exposure to slag from incidental ingestion or inhalation exposure.
- Children living near the sample locations along Davis Avenue, 260th Street, and Holly Avenue may experience adverse health impacts from exposure to slag from incidental ingestion.
- Children living near the sample locations along Davis Avenue, 260th Street, and Holly Avenue are not at risk of adverse health impacts from exposure to slag from inhalation exposure.
- Adults living near the sample location along Davis Avenue, 260th Street, and Holly Avenue are not at risk of adverse health impacts from exposure to slag from incidental ingestion or inhalation exposure.
- An evaluation of the potential for causing adverse health impacts from direct ingestion of slag by children who exhibit pica behavior – that is, eating non-food items – was completed. The conclusion of this health consultation is that children who exhibit pica behavior would be at risk of adverse health impacts if they played in areas covered by slag similar to the slag that is located at the road sections sampled. Since it is unlikely that children will be playing in the county roads, the county roads do not pose a significant risk of adverse health impacts through the direct ingestion route of exposure.

Recommendations

The potential for adverse health impacts from exposure to steel slag applied to county roads in Muscatine County is not same for each section of road. The potential for adverse health impacts will depend upon the concentration of manganese found at each road section. The material deposited on some of the road sections evaluated (Trolley Avenue and Independence Avenue) do not pose a health risk to children and adults, while other road sections evaluated (Davis Avenue, 260th Street, and Holly Avenue) do pose a health risk to children.

It is possible to determine at which concentration of manganese within roads would begin to pose adverse health impacts upon children living near these roads. From the toxicological studies it was determined that exposure to manganese above a dose of 0.08 mg/kg/day for children has the potential to cause adverse health impacts. The concentration of manganese within a road section slag that may begin to produces an adverse health impact is determine by the equation below.

$$\frac{0.08 \text{ mg Mn}}{\text{kg body weight x day}} \times \frac{\text{day}}{100 \text{ mg soil}} \times \frac{1{,}000{,}000 \text{ mg soil}}{\text{kg soil}} \times \frac{15 \text{ kg body weight}}{}$$

= 12,000 mg Mn / kg soil

A manganese concentration above 12,000 mg/kg within the steel slag, as determined by sampling at the road location, has the potential to produce adverse health impacts to children living near the road. Muscatine County may wish to consider evaluating each road section where steel slag is present to determine if each particular section of road has the potential to cause adverse health impacts to children living near that road. For sections of the county road where the average concentration of manganese is above 12,000 mg/kg consideration needs to be made to seal this section of road or provide some type of dust control to limit exposure to elevated levels of manganese.

The evaluation included in this health consultation concluded that direct ingestion of the steel slag deposited on the county roads could pose a health concern for children who routinely ingest non-food items such as soil. Because of this, it is recommended steel slag not be used for private lanes or driveways unless the slag material is covered with asphalt or concrete. Steel slag is not recommended for landscaping covering because of the potential for direct exposure of the steel slag to children.

Tables

Table 1 – Sampling Areas of Muscatine County Roads

Date of Application	Street – Route	Tons Applied	Road Direction
6/11/2018	Davis Ave. – 1	273.22	N – S
6/11/2018	Trolly Ave. – 2	224.96	E – W
5/24/2018	Independence Ave. – 3	355.63	E – W
6/4/2018	260^{th} – 5	258.87	E – W
5/22/2018	Davis Ave. – 10	387.00	E – W
5/23/2018	Holly Ave. – Holly	218.28	N – S

Table 2 – Concentration of Chemical Substances with Slag on Road (1-4-W)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	3.5
Barium	180
Beryllium	<2.0
Boron	75
Cadmium	13
Chromium, Total	1,400
Cobalt	4.3
Copper	100
Fluoride	11
Lead	20
Lithium	6.7
Manganese	15,000
Mercury	<1.0
Molybdenum	15
Nickel	62
Selenium	<1.0
Silver	3.4
Strontium	140
Thallium	<1.0
Tin	<10
Vanadium	230
Zinc	570

Table 3 – Concentration of Chemical Substances with Slag on Road (1-13-E)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	3.3
Barium	160
Beryllium	<2.0
Boron	70
Cadmium	14
Chromium, Hexavalent	<1.0
Chromium, Total	1,000
Cobalt	<5.0
Copper	100
Fluoride	9.3
Lead	22
Lithium	6.6
Manganese	11,000
Mercury	<1.0
Molybdenum	17
Nickel	62
Selenium	<5.0
Silver	3.3
Strontium	150
Thallium	<1.0
Tin	<10
Vanadium	170
Zinc	490

Table 4 – Concentration of Chemical Substances with Slag on Road (1-15-E)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.6
Barium	150
Beryllium	<2.0
Boron	65
Cadmium	11
Chromium, Total	1,100
Cobalt	4.3
Copper	83
Fluoride	10
Lead	19
Lithium	5.8
Manganese	11,000
Mercury	<1.0
Molybdenum	11
Nickel	60
Selenium	<1.0
Silver	2.2
Strontium	130
Thallium	<1.0
Tin	<10
Vanadium	200
Zinc	500

Table 5 – Concentration of Chemical Substances with Slag on Road (1-19-NE)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.5
Barium	130
Beryllium	<2.0
Boron	62
Cadmium	10
Chromium, Total	910
Cobalt	4.1
Copper	69
Fluoride	7.4
Lead	18
Lithium	12
Manganese	11,000
Mercury	<1.0
Molybdenum	10
Nickel	56
Selenium	<1.0
Silver	2.2
Strontium	120
Thallium	<1.0
Tin	<10
Vanadium	160
Zinc	310

Table 6 – Concentration of Chemical Substances with Slag on Road (2-1-SE)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	3.4
Barium	83
Beryllium	<2.0
Boron	31
Cadmium	2.7
Chromium, Hexavalent	<1.0
Chromium, Total	500
Cobalt	<5.0
Copper	39
Fluoride	4.6
Lead	13
Lithium	3.6
Manganese	4,000
Mercury	<1.0
Molybdenum	7.2
Nickel	30
Selenium	<1.0
Silver	<1.0
Strontium	110
Thallium	<1.0
Tin	<10
Vanadium	65
Zinc	140

Table 7 – Concentration of Chemical Substances with Slag on Road (2-6-W)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	3.3
Barium	130
Beryllium	<2.0
Boron	38
Cadmium	6.8
Chromium, Hexavalent	<1.0
Chromium, Total	620
Cobalt	<5.0
Copper	55
Fluoride	12
Lead	29
Lithium	5.7
Manganese	5,900
Mercury	<1.0
Molybdenum	7.9
Nickel	33
Selenium	<1.0
Silver	1.7
Strontium	120
Thallium	<1.0
Tin	<10
Vanadium	100
Zinc	420

Table 8 – Concentration of Chemical Substances with Slag on Road (2-20-NW)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	4.2
Barium	180
Beryllium	<2.0
Boron	70
Cadmium	12
Chromium, Hexavalent	<1.0
Chromium, Total	1,000
Cobalt	<5.0
Copper	110
Fluoride	5
Lead	48
Lithium	9.1
Manganese	9,600
Mercury	<1.0
Molybdenum	17
Nickel	63
Selenium	<1.0
Silver	3.4
Strontium	150
Thallium	<1.0
Tin	<10
Vanadium	160
Zinc	870

Table 9 – Concentration of Chemical Substances with Slag on Road (3-2-SW)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	3.3
Barium	100
Beryllium	<2.0
Boron	49
Cadmium	6.1
Chromium, Hexavalent	<1.0
Chromium, Total	760
Cobalt	<5.0
Copper	44
Fluoride	8.6
Lead	15
Lithium	4.2
Manganese	7,100
Mercury	<1.0
Molybdenum	7.2
Nickel	32
Selenium	<1.0
Silver	1.4
Strontium	120
Thallium	<1.0
Tin	<10
Vanadium	120
Zinc	230

Table 10 – Concentration of Chemical Substances with Slag on Road (3-2-SW DF)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	1.5
Barium	80
Beryllium	<2.0
Boron	43
Cadmium	6.6
Chromium, Hexavalent	<1.0
Chromium, Total	520
Cobalt	<5.0
Copper	40
Fluoride	8.6
Lead	14
Lithium	4.2
Manganese	5,700
Mercury	<1.0
Molybdenum	5.8
Nickel	30
Selenium	<1.0
Silver	1.6
Strontium	110
Thallium	<1.0
Tin	<10
Vanadium	84
Zinc	210

Table 11 – Concentration of Chemical Substances with Slag on Road (3-9-E)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	1.6
Barium	67
Beryllium	<2.0
Boron	41
Cadmium	5.8
Chromium, Hexavalent	<1.0
Chromium, Total	390
Cobalt	<5.0
Copper	34
Fluoride	8.6
Lead	11
Lithium	3.5
Manganese	4,700
Mercury	<1.0
Molybdenum	5.1
Nickel	27
Selenium	<1.0
Silver	1.2
Strontium	110
Thallium	<1.0
Tin	<10
Vanadium	81
Zinc	140

Table 12 – Concentration of Chemical Substances with Slag on Road (3-12-W)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.9
Barium	60
Beryllium	<2.0
Boron	46
Cadmium	4.8
Chromium, Total	430
Chromium, Hexavalent	<1.0
Cobalt	<5
Copper	52
Fluoride	11
Lead	13
Lithium	3.4
Manganese	5,300
Mercury	<1.0
Molybdenum	5.9
Nickel	29
Selenium	<5.0
Silver	1.1
Strontium	100
Thallium	<1.0
Tin	<10
Vanadium	72
Zinc	230

Table 13 – Concentration of Chemical Substances with Slag on Road (3-16-W)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.5
Barium	97
Beryllium	<2.0
Boron	50
Cadmium	8.1
Chromium, Total	630
Chromium, Hexavalent	<1.0
Cobalt	<5
Copper	63
Fluoride	10
Lead	16
Lithium	4.3
Manganese	7,100
Mercury	<1.0
Molybdenum	6.9
Nickel	34
Selenium	<1.0
Silver	1.7
Strontium	120
Thallium	<1.0
Tin	<10
Vanadium	100
Zinc	260

Table 14 – Concentration of Chemical Substances with Slag on Road (5-1-SE)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.4
Barium	130
Beryllium	<2.0
Boron	62
Cadmium	9.1
Chromium, Total	950
Cobalt	3.1
Copper	73
Fluoride	12
Lead	17
Lithium	5.2
Manganese	11,000
Mercury	<1.0
Molybdenum	9.7
Nickel	33
Selenium	<1.0
Silver	2.1
Strontium	120
Thallium	<1.0
Tin	<10
Vanadium	150
Zinc	340

Table 15 – Concentration of Chemical Substances with Slag on Road (5-12-N)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.2
Barium	130
Beryllium	<2.0
Boron	58
Cadmium	6.6
Chromium, Total	940
Chromium, Hexavalent	<1.0
Cobalt	<5.0
Copper	85
Fluoride	6.4
Lead	20
Lithium	5.3
Manganese	10,000
Mercury	<1.0
Molybdenum	11
Nickel	31
Selenium	<5.0
Silver	2
Strontium	120
Thallium	<1.0
Tin	<10
Vanadium	140
Zinc	450

Table 16 – Concentration of Chemical Substances with Slag on Road (10-1-SE)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	1.3
Barium	15
Beryllium	<2.0
Boron	13
Cadmium	<2.0
Chromium, Total	4.4
Chromium, Hexavalent	<1.0
Fluoride	<1.0
Iron	4,800
Lead	<10
Lithium	1.5
Manganese	1,400
Mercury	<1.0
Molybdenum	<5.0
Nickel	19
Selenium	<1.0
Silver	<1.0
Strontium	120
Thallium	<1.0
Tin	<10
Vanadium	<5.0
Zinc	25

Table 17 – Concentration of Chemical Substances with Slag on Road (10-4-N)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2
Barium	29
Beryllium	<2.0
Boron	17
Cadmium	<2.0
Chromium, Total	5.6
Chromium, Hexavalent	<1.0
Fluoride	1.1
Iron	5,700
Lead	<10
Lithium	2.7
Manganese	2,400
Mercury	<1.0
Molybdenum	<5.0
Nickel	41
Selenium	<1.0
Silver	<1.0
Strontium	170
Thallium	<1.0
Tin	<10
Vanadium	6.1
Zinc	29

Table 18 – Concentration of Chemical Substances with Slag on Road (10-5-S)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	1.1
Barium	12
Beryllium	<2.0
Boron	12
Cadmium	<2.0
Chromium, Total	3.9
Chromium, Hexavalent	<1.0
Fluoride	<1.0
Iron	4,200
Lead	<10
Lithium	1.2
Manganese	1,300
Mercury	<1.0
Molybdenum	<5.0
Nickel	20
Selenium	1.1
Silver	<1.0
Strontium	130
Thallium	<1.0
Tin	<10
Vanadium	<5.0
Zinc	40

Table 19 – Concentration of Chemical Substances with Slag on Road (10-10-NW)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	1.9
Barium	16
Beryllium	<2.0
Boron	14
Cadmium	<2.0
Chromium, Total	3.8
Chromium, Hexavalent	<1.0
Fluoride	<1.0
Iron	4,700
Lead	<10
Lithium	2.1
Manganese	2,600
Mercury	<1.0
Molybdenum	<5.0
Nickel	45
Selenium	1.1
Silver	<1.0
Strontium	200
Thallium	<1.0
Tin	<10
Vanadium	<5.0
Zinc	13

Table 20 – Concentration of Chemical Substances with Slag on Road (10-10-NW-FD)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.3
Barium	20
Beryllium	<2.0
Boron	13
Cadmium	<2.0
Chromium, Total	3.6
Chromium, Hexavalent	<1.0
Fluoride	<1.0
Iron	5,100
Lead	<10
Lithium	1.9
Manganese	2,500
Mercury	<1.0
Molybdenum	<5.0
Nickel	46
Selenium	1.2
Silver	<1.0
Strontium	190
Thallium	<1.0
Tin	<10
Vanadium	<5.0
Zinc	55

Table 21 – Concentration of Chemical Substances with Slag on Road (1333-Holly-E)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.6
Barium	260
Beryllium	<2.0
Boron	95
Cadmium	9.3
Chromium, Total	2,100
Chromium, Hexavalent	<1.0
Fluoride	8.3
Iron	11,000
Lead	40
Lithium	8.2
Manganese	19,000
Mercury	<1.0
Molybdenum	20
Nickel	40
Selenium	1.5
Silver	3.8
Strontium	170
Thallium	<1.0
Tin	<10
Vanadium	340
Zinc	450

Table 22 – Concentration of Chemical Substances with Slag on Road (1333-Holly-W)

Substance	Concentration (mg/kg)
Antimony	<5.0
Arsenic	2.6
Barium	160
Beryllium	<2.0
Boron	62
Cadmium	6.3
Chromium, Total	1,100
Chromium, Hexavalent	<1.0
Fluoride	6.6
Iron	69,000
Lead	29
Lithium	6.3
Manganese	12,000
Mercury	<1.0
Molybdenum	13
Nickel	34
Selenium	1.5
Silver	1.9
Strontium	150
Thallium	<1.0
Tin	<10
Vanadium	200
Zinc	310

Table 23 – Concentration of Chemical Substances with Slag on Road (E-1) (125 to 63 microns)

Substance	Concentration (mg/kg)
Arsenic	2.1
Cadmium	12
Iron	94,500
Manganese	12,000
Vanadium	180

Table 24 – Concentration of Chemical Substances with Slag on Road (E-2) (< 63 microns)

Substance	Concentration (mg/kg)
Arsenic	2
Cadmium	10
Iron	69,100
Manganese	9,100
Vanadium	170

Table 25 – Concentration of Chemical Substances with Slag on Road (W-1) (125 to 63 microns)

Substance	Concentration (mg/kg)
Arsenic	1.6
Cadmium	8.7
Iron	60,100
Manganese	7,900
Vanadium	140

Table 26 – Concentration of Chemical Substances with Slag on Road (W-2) (< 63 microns)

Substance	Concentration (mg/kg)
Arsenic	2.1
Cadmium	7.3
Iron	47,900
Manganese	6,700
Vanadium	140

Table 27 – ATSDR Comparison Values for Metals within Soil

Metal	Comparison Value (mg/kg)	Exposure Frequency	Person
Antimony	21	Chronic	Child
	320	Chronic	Adult
	31	Intermediate	Child
	3.2	Intermediate	Pica Child
	480	Intermediate	Adult
	52,000	Acute	Child
	5,300	Acute	Pica Child
	800,000	Acute	Adult
Arsenic	16	Chronic	Child
	240	Chronic	Adult
	0.26	Chronic (cancer)	Child, Adult
	260	Acute	Child
	27	Acute	Pica Child
	4,000	Acute	Adult
Barium	10,000	Chronic	Child
	160,000	Chronic	Adult
	10,000	Intermediate	Child
	1,100	Intermediate	Pica Child
	160,000	Intermediate	Adult
Beryllium	100	Chronic	Child
	1,600	Chronic	Adult
Boron	10,000	Chronic	Child
	160,000	Chronic	Adult
	10,000	Intermediate	Child
	1,100	Intermediate	Pica Child
	160,000	Intermediate	Adult
	10,000	Acute	Child
	1,100	Acute	Pica Child
	160,000	Acute	Adult
Cadmium	5.2	Chronic	Child
	400	Chronic	Adult
	26	Intermediate	Child
	2.7	Intermediate	Pica Child
	400	Intermediate	Adult

Table 27 – ATSDR Comparison Values for Metals within Soil (Cont.)

Metal	Comparison Value (mg/kg)	Exposure Frequency	Person
Chromium, Hexavalent	47	Chronic	Child
	720	Chronic	Adult
	260	Intermediate	Child
	27	Intermediate	Pica Child
	4,000	Intermediate	Adult
Chromium, Trivalent	78,000	Chronic	Child
	1,200,000	Chronic	Adult
Cobalt	520	Intermediate	Child
	53	Intermediate	Pica Child
	8,000	Intermediate	Adult
Fluoride	3,100	Chronic	Child
	48,000	Chronic	Adult
Manganese	2,600	Chronic	Child
	40,000	Chronic	Adult
Molybdenum	260	Chronic	Child
	4,000	Chronic	Adult
	420	Intermediate	Child
	43	Intermediate	Pica Child
	6,400	Intermediate	Adult
	2,600	Acute	Child
	270	Acute	Pica Child
	40,000	Acute	Adult
Nickel	1,000	Chronic	Child
	16,000	Chronic	Adult
Silver	260	Chronic	Child
	4,000	Chronic	Adult
Selenium	260	Chronic	Child
	4,000	Chronic	Adult
Strontium	31,000	Chronic	Child
	480,000	Chronic	Adult
	100,000	Intermediate	Child
	11,000	Intermediate	Pica Child
	1,600,000	Intermediate	Adult

Table 27 – ATSDR Comparison Values for Metals within Soil (Cont.)

Metal	Comparison Value (mg/kg)	Exposure Frequency	Person
Vanadium	520	Intermediate	Child
	53	Intermediate	Pica Child
	8,000	Intermediate	Adult
Zinc	16,000	Chronic	Child
	240,000	Chronic	Adult
	16,000	Intermediate	Child
	1,600	Intermediate	Pica Child
	240,000	Intermediate	Adult

Table 28 – IDNR Statewide Standards for Metals within Soil

Metal	Statewide Standard (mg/kg)	Exposure Frequency	Person
Antimony	31	Chronic (Oral, Dermal)	Child
Arsenic	1.9	Chronic (Oral, Dermal)	Child
Barium	15,000	Chronic (Oral, Dermal)	Child
Beryllium	110	Chronic (Oral, Dermal)	Child
Boron	16,000	Chronic (Oral, Dermal)	Child
Cadmium	70	Chronic (Oral, Dermal)	Child
Chromium, Total	190	Chronic (Oral, Dermal)	Child
Cobalt	23	Chronic (Oral, Dermal)	Child
Fluoride	4,700	Chronic (Oral, Dermal)	Child
Lead	400	Chronic (Oral, Dermal)	Child
Lithium	160	Chronic (Oral, Dermal)	Child
Manganese	10,000	Chronic (Oral, Dermal)	Child
Mercury	23	Chronic (Oral, Dermal)	Child
Molybdenum	390	Chronic (Oral, Dermal)	Child
Nickel	1,500	Chronic (Oral, Dermal)	Child
Selenium	390	Chronic (Oral, Dermal)	Child
Silver	370	Chronic (Oral, Dermal)	Child
Strontium	47,000	Chronic (Oral, Dermal)	Child
Thallium	0.78	Chronic (Oral, Dermal)	Child
Vanadium	350	Chronic (Oral, Dermal)	Child
Zinc	23,000	Chronic (Oral, Dermal)	Child

Table 29 – Lowest Comparison Values for Metals within Soil

Metal	Comparison Value (mg/kg)	Exposure Frequency	Person
Antimony	3.2	Intermediate	Pica Child
Arsenic	0.26	Chronic (Cancer)	Child, Adult
Barium	1,100	Intermediate	Pica Child
Beryllium	100	Chronic	Child
Boron	1,100	Intermediate, Acute	Pica Child
Cadmium	2.7	Intermediate	Pica Child
Chromium, Hexavalent	27	Intermediate	Pica Child
Chromium, Trivalent	78,000	Chronic	Child
Cobalt	23	Chronic (Oral, Dermal)	Child
Fluoride	3,100	Chronic	Child
Lead	400	Chronic (Oral, Dermal)	Child
Lithium	160	Chronic (Oral, Dermal)	Child
Manganese	2,600	Chronic	Child
Mercury	23	Chronic (Oral, Dermal)	Child
Molybdenum	43	Intermediate	Pica Child
Nickel	1,000	Chronic	Child
Selenium	260	Chronic	Child
Silver	260	Chronic	Child
Strontium	11,000	Intermediate	Pica Child
Thallium	0.78	Chronic (Oral, Dermal)	Child

Table 29 – Lowest Comparison Values for Metals within Soil (Cont.)

Metal	Comparison Value (mg/kg)	Exposure Frequency	Person
Vanadium	53	Intermediate	Child
Zinc	1,600	Intermediate	Pica Child

Table 30 – Sampling Results above Comparison Values

Location	Metal	Concentration (mg/kg)	Exposure Frequency	Person at Risk
1-4-W	Arsenic	3.5	Chronic (Cancer)	Child, Adult
	Cadmium	13	Intermediate	Pica Child
	Manganese	15,000	Chronic	Child
	Vanadium	230	Intermediate	Child
1-13-E	Arsenic	3.3	Chronic (Cancer)	Child, Adult
	Cadmium	14	Intermediate	Pica Child
	Manganese	11,000	Chronic	Child
	Vanadium	170	Intermediate	Child
1-15-E	Arsenic	2.6	Chronic (Cancer)	Child, Adult
	Cadmium	11	Intermediate	Pica Child
	Manganese	11,000	Chronic	Child
	Vanadium	200	Intermediate	Child
1-19-E	Arsenic	2.5	Chronic (Cancer)	Child, Adult
	Cadmium	10	Intermediate	Pica Child
	Manganese	11,000	Chronic	Child
	Vanadium	160	Intermediate	Child
2-1-SE	Arsenic	3.4	Chronic (Cancer)	Child, Adult
	Manganese	4,000	Chronic	Child
	Vanadium	65	Intermediate	Child
2-6-W	Arsenic	3.3	Chronic (Cancer)	Child, Adult
	Cadmium	6.8	Intermediate	Pica Child
	Manganese	5,900	Chronic	Child
	Vanadium	100	Intermediate	Child
2-20-NW	Arsenic	4.2	Chronic (Cancer)	Child, Adult
	Cadmium	12	Intermediate	Pica Child
	Manganese	9,600	Chronic	Child
	Vanadium	160	Intermediate	Child
3-2-SW	Arsenic	3.3	Chronic (Cancer)	Child, Adult
	Cadmium	6.1	Intermediate	Pica Child
	Manganese	7,100	Chronic	Child
	Vanadium	120	Intermediate	Child

Table 30 – Sampling Results above Comparison Values (Cont.)

Location	Metal	Concentration (mg/kg)	Exposure Frequency	Person at Risk
3-2-SW-DW	Arsenic	1.5	Chronic (Cancer)	Child, Adult
	Cadmium	6.6	Intermediate	Pica Child
	Manganese	5,700	Chronic	Child
	Vanadium	84	Intermediate	Child
3-9-E	Arsenic	1.6	Chronic (Cancer)	Child, Adult
	Cadmium	5.8	Intermediate	Pica Child
	Manganese	4,700	Chronic	Child
	Vanadium	81	Intermediate	Child
3-12-W	Arsenic	2.9	Chronic (Cancer)	Child, Adult
	Cadmium	4.8	Intermediate	Pica Child
	Manganese	5,300	Chronic	Child
	Vanadium	72	Intermediate	Child
3-16-W	Arsenic	2.5	Chronic (Cancer)	Child, Adult
	Cadmium	8.1	Intermediate	Pica Child
	Manganese	7,100	Chronic	Child
	Vanadium	100	Intermediate	Child
5-1-SE	Arsenic	2.4	Chronic (cancer)	Child, Adult
	Cadmium	9.1	Intermediate	Pica Child
	Manganese	11,000	Chronic	Child
	Vanadium	150	Intermediate	Child
5-12-N	Arsenic	2.2	Chronic (cancer)	Child, Adult
	Cadmium	6.6	Intermediate	Pica Child
	Manganese	10,000	Chronic	Child
	Vanadium	140	Intermediate	Child
10-1-SE	Arsenic	1.3	Chronic (cancer)	Child, Adult
10-4-N	Arsenic	2	Chronic (cancer)	Child, Adult
10-5-S	Arsenic	1.1	Chronic (cancer)	Child, Adult
10-10-NW	Arsenic	1.9	Chronic (cancer)	Child, Adult
10-10-NW-FD	Arsenic	2.3	Chronic (cancer)	Child, Adult

Table 30 – Sampling Results above Comparison Values (Cont.)

Location	Metal	Concentration (mg/kg)	Exposure Frequency	Person at Risk
1333-Holly-E	Arsenic	2.6	Chronic (cancer)	Child, Adult
	Cadmium	9.3	Intermediate	Pica Child
	Manganese	19,000	Chronic	Child
	Vanadium	340	Intermediate	Child
1333-Holly-W	Arsenic	2.6	Chronic (cancer)	Child, Adult
	Cadmium	6.3	Intermediate	Pica Child
	Manganese	12,000	Chronic	Child
	Vanadium	200	Intermediate	Child

Table 31 – Estimated Upper Bound Average Concentration of Manganese

Road Section	Manganese (mg/kg)
1 – Davis Ave.	14,137
2 – Trolley Ave.	8,971
3 – Independence Ave.	8,868
5 – 260th Street	14,413
10 – 132nd Street	2,074

Table 32 – Concentrations of Metals (Above Comparison Values) at Road Sections Used In Evaluation

Road Section	Concentration of Metals (mg/kg)			
	Arsenic	Cadmium	Manganese	Vanadium
1 – Davis Ave.	3.5	14	14,137	230
2 – Trolley Ave.	4.2	12	8,971	160
3 – Independence Ave.	3.3	8.1	8,868	120
5 – 260th Street	2.4	9.1	14,413	150
10 – 132nd Street	2.3	*	*	*
Holly Avenue	2.6	9.3	19,000	340

* The concentration of cadmium, manganese, and vanadium were below comparison values at the 132nd Street location.

Table 33 – Dose Level for Ingestion Exposure to Metals within Slag – Davis Avenue

Type of Exposure	Person	Metal	Dose Level (mg/kg/day)
Incidental Ingestion	Child	Arsenic	0.000023
		Cadmium	0.000093
		Manganese	0.094
		Vanadium	0.0015
Incidental Ingestion	Adult	Arsenic	0.0000022
		Cadmium	0.0000088
		Manganese	0.0088
		Vanadium	0.00014
Direct Consumption	Pica Child	Arsenic	0.00023
		Cadmium	0.00093
		Manganese	0.94
		Vanadium	0.015

Table 34 – Dose Level for Ingestion Exposure to Metals within Slag – Trolley Avenue

Type of Exposure	Person	Metal	Dose Level (mg/kg/day)
Incidental Ingestion	Child	Arsenic	0.000028
		Cadmium	0.00008
		Manganese	0.060
		Vanadium	0.0011
Incidental Ingestion	Adult	Arsenic	0.0000026
		Cadmium	0.0000075
		Manganese	0.0056
		Vanadium	0.0001
Direct Consumption	Pica Child	Arsenic	0.00028
		Cadmium	0.0008
		Manganese	0.60
		Vanadium	0.011

Table 35 – Dose Level for Ingestion Exposure to Metals within Slag – Independence Avenue

Type of Exposure	Person	Metal	Dose Level (mg/kg/day)
Incidental Ingestion	Child	Arsenic	0.000022
		Cadmium	0.000054
		Manganese	0.059
		Vanadium	0.0008
Incidental Ingestion	Adult	Arsenic	0.0000021
		Cadmium	0.0000051
		Manganese	0.0055
		Vanadium	0.000075
Direct Consumption	Pica Child	Arsenic	0.00022
		Cadmium	0.00054
		Manganese	0.59
		Vanadium	0.008

Table 36 – Dose Level for Ingestion Exposure to Metals within Slag – 260th Street

Type of Exposure	Person	Metal	Dose Level (mg/kg/day)
Incidental Ingestion	Child	Arsenic	0.000016
		Cadmium	0.000061
		Manganese	0.096
		Vanadium	0.001
Incidental Ingestion	Adult	Arsenic	0.0000015
		Cadmium	0.0000057
		Manganese	0.009
		Vanadium	0.000094
Direct Consumption	Pica Child	Arsenic	0.00016
		Cadmium	0.00061
		Manganese	0.96
		Vanadium	0.01

Table 37 – Dose Level for Ingestion Exposure to Metals within Slag – 132nd Street

Type of Exposure	Person	Metal	Dose Level (mg/kg/day)
Incidental Ingestion	Child	Arsenic	0.000016
Incidental Ingestion	Adult	Arsenic	0.0000014
Direct Consumption	Pica Child	Arsenic	0.00015

Table 38 – Dose Level for Ingestion Exposure to Metals within Slag – Holly Avenue

Type of Exposure	Person	Metal	Dose Level (mg/kg/day)
Incidental Ingestion	Child	Arsenic	0.000017
		Cadmium	0.000062
		Manganese	0.13
		Vanadium	0.0023
Incidental Ingestion	Adult	Arsenic	0.0000016
		Cadmium	0.0000058
		Manganese	0.012
		Vanadium	0.00021
Direct Consumption	Pica Child	Arsenic	0.00017
		Cadmium	0.00062
		Manganese	1.27
		Vanadium	0.023

Table 39 – Road Section Locations and Manganese Ingestion Exposure Scenarios of Health Concern

Road Section	Exposure Scenario
Davis Avenue	Incidental Ingestion – Child Direct Ingestion – Pica Child
Trolley Avenue	Direct Ingestion – Pica Child
Independence Avenue	Direct Ingestion – Pica Child
260th Street	Incidental Ingestion – Child Direct Ingestion – Pica Child
Holly Avenue	Incidental Ingestion – Child Direct Ingestion – Pica Child

Table 40 – Potential for Adverse Health Impacts from Steel Slag Exposure

	Incidental Ingestion		Inhalation		Road Worker
Road Location	Child	Adult	Child	Adult	
Davis Ave.	Yes	No	No	No	No
Trolley Ave.	No	No	No	No	No
Independence Ave.	No	No	No	No	No
260th St.	Yes	No	No	No	No
132nd St.	Yes	No	No	No	No
Holly Ave.	Yes	No	No	No	No

Figures

Figure 1 – Statistical Analysis of XRF Readings along Davis Avenue

SSAB/Harsco #1

Descriptive Statistics: Results for Manganese Concentrations, Road Section # 1, 2051 Davis Avenue

The results of some basic statistical tests performed at 11:49 on 24-MAY-2019.

20 data points (XRF Screening Values) were entered:
0.436E+04 0.443E+04 0.470E+04 0.510E+04 0.531E+04 0.563E+04 0.572E+04 0.579E+04 0.580E+04 0.582E+04 0.583E+04 0.586E+04 0.587E+04 0.604E+04 0.607E+04 0.617E+04 0.663E+04 0.696E+04 0.703E+04 0.742E+04

Mean = 5.828E+03

95% confidence interval for actual Mean: 5450. thru 6206.

Standard Deviation = 807.

Hi = 7.423E+03

Low = 4.365E+03

Median = 5.825E+03

Average Absolute Deviation from Median = 562.

Corrected XRF Values

After correlating XRF screening values to SHL results (XRF screened results X upper 95% confidence boundary – 2.278 - of discrepancy between SHL and XRF)

Mean = 5828 X 2.278 = 13,276

95% confidence interval for actual Mean:

Lower limit 5450 X 2.278 = 12,415

Upper limit 6206 X 2.278 = 14,137

Figure 2 – Statistical Analysis of XRF Readings along Trolley Avenue

SSAB/Harsco #2

Descriptive Statistics: Results for Manganese Concentrations, Road Section # 2, 2075 Trolley Avenue

The results of some basic statistical tests performed at 13:53 on 20-JUN-2019.

13 data points (XRF Screening Values) were entered:
0.195E+04 0.197E+04 0.235E+04 0.265E+04 0.270E+04 0.283E+04 0.303E+04 0.322E+04 0.323E+04 0.331E+04 0.331E+04 0.535E+04 0.599E+04

Mean = 3.221E+03

95% confidence interval for actual Mean: 2,503 thru 3,938.

Standard Deviation = 1.188E+03

Hi = 5.988E+03

Low = 1.953E+03

Median = 3.029E+03

Average Absolute Deviation from Median = 765.

Corrected XRF Values

After correlating XRF screening values to SHL results (XRF screened results X upper 95% confidence boundary – 2.278- of discrepancy between SHL and XRF)

Mean = (3,221 X 2.278) = 7,337

95% confidence interval for actual Mean:

Lower limit = (2,503 X 2.278) = 5,702

Upper limit = (3,938 X 2.278) = 8,971

Figure 3 – Statistical Analysis of XRF Readings along Independence Avenue

SSAB/Harsco #3

Descriptive Statistics: Results for Manganese Concentrations, Road Section # 3, 2670 Independence Avenue

The results of some basic statistical tests performed at 14:07 on 20-JUN-2019.

15 data points (XRF Screening Values) were entered:
0.273E+04 0.282E+04 0.306E+04 0.308E+04 0.317E+04 0.338E+04 0.344E+04 0.356E+04
0.378E+04 0.387E+04 0.399E+04 0.407E+04 0.407E+04 0.422E+04 0.458E+04

Mean = 3.589E+03

95% confidence interval for actual Mean: 3,284. thru 3,893.

Standard Deviation = 549.

Hi = 4.585E+03

Low = 2.729E+03

Median = 3.556E+03

Average Absolute Deviation from Median = 459.

Corrected XRF Values

After correlating XRF screening values to SHL results (XRF screened results X upper 95% confidence boundary – 2.278- of discrepancy between SHL and XRF)

Mean = (3,589 X 2.278) = 8,176

95% confidence interval for actual Mean:

Lower limit = (3,284 X 2.278) = 7,480

Upper limit = (3,893 X 2.278) = 8,868

Figure 4 – Statistical Analysis of XRF Readings along 260th Street

Basic Stats for SSAB/Harsco/SS, Manganese Concentration (mg/kg)

Sample Location # 5 at 1072 260th Street.

Descriptive Statistics: Results

The results of some basic statistical tests performed at 09:55 on 6-AUG-2019.

20 data points were entered:
0.350E+04 0.422E+04 0.438E+04 0.456E+04 0.468E+04 0.488E+04 0.500E+04 0.523E+04 0.523E+04 0.524E+04 0.528E+04 0.551E+04 0.554E+04 0.557E+04 0.565E+04 0.586E+04 0.602E+04 0.619E+04 0.632E+04 0.633E+04

Mean = 5.259E+03

95% confidence interval for actual Mean: 4912. thru 5606.

Standard Deviation = 742.

Hi = 6.327E+03

Low = 3.500E+03

Median = 5.255E+03

Average Absolute Deviation from Median = 568

Corrected XRF Values

After correlating XRF screening values to SHL results (XRF screened results X upper 95% confidence boundary – 2.278 - of ratio of SHL to XRF)

Mean = 5259 X 2.278 = 11,980

95% confidence interval for actual Mean:

Lower limit 3500 X 2.278 = 7,973

Upper limit 6327 X 2.278 = 14,413

Figure 5 – Statistical Analysis of XRF Readings along 131st Street

SSAB_#10_Stats: XRF Results Mn Concentrations for Site #10, 131st Street

http://www.physics.csbsju.edu/cgi-bin/stats/cstats

The results of some basic statistical tests performed at 08:26 on 6-AUG-2019.

11 data points were entered:
0.126E+04 0.130E+04 0.134E+04 0.135E+04 0.144E+04 0.153E+04 0.205E+04 0.210E+04 0.249E+04 0.252E+04 0.261E+04

Mean = 1.818E+03

95% confidence interval for actual Mean: 1453. thru 2183.

Standard Deviation = 543.

Hi = 2.612E+03

Low = 1.263E+03

Median = 1.533E+03

Average Absolute Deviation from Median = 461

Corrected XRF Values

After correlating XRF screening values to SHL results (XRF screened results X lower 95% confidence boundary – 0.95- of discrepancy between SHL and XRF)

Mean = (1,818 X 0.95) = 1,727

95% confidence interval for actual Mean:

Lower limit = (1,453 X 0.95) = 1,380

Upper limit = (2,183 X 0.95) = 2,074

Appendix A

Collection Location	Collector and Phone	Client Reference	Accession #
#1_13_e	jackson hylton 515/825-8338	ssab harsco	805937 CORRECTED REPORT 1
MUSCATINE,	Collected 2019-05-03 11:39	Received 2019-05-09 15:26	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Anions, EPA 300.0				*4*
Fluoride	**9.3**	**5**		

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*3*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/L)	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7470A (SPLP)			
Mercury	**<0.002**	**0.002**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Manganese	**11000**	**2**	
Metals, EPA 6020			
Copper	**100**	**5**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**3.3**	**1**	
Barium	**160**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**14**	**2**	
Chromium	**1000**	**2**	
Cobalt	**<5.0**	**5**	
Lead	**22**	**10**	
Molybdenum	**17**	**5**	
Nickel	**62**	**5**	
Selenium	**<5.0**	**5**	
Silver	**3.3**	**1**	
Strontium	**150**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**170**	**5**	
Zinc	**490**	**2**	
Metals, EPA 6010 D			*2*
Boron	**70**	**5.0**	

Collection Location	Collector	Client Reference	Accession #	
#1_13_e	jackson hylton	ssab harsco	805937	CORRECTED REPORT 1

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Lithium	**6.6**	**1.0**	

TEST	RESULT (mg/L)	QUANT LIMIT	ANALYSIS NOTE(S)
Metals, EPA 6020			
Antimony	**<0.006**	**0.006**	
Arsenic	**<0.01**	**0.01**	
Barium	**<2.0**	**2**	
Beryllium	**<0.004**	**0.004**	
Cadmium	**<0.005**	**0.005**	
Chromium	**<0.1**	**0.1**	
Copper	**<1.0**	**1**	
Lead	**<0.015**	**0.015**	
Manganese	**<0.05**	**0.05**	
Molybdenum	**<0.05**	**0.05**	
Nickel	**<0.1**	**0.1**	
Selenium	**<0.05**	**0.05**	
Silver	**<0.1**	**0.1**	
Thallium	**<0.002**	**0.002**	
Vanadium	**<0.05**	**0.05**	
Zinc	**<0.1**	**0.1**	
Cobalt	**<0.05**	**0.05**	
Metals, EPA 6010 D			
Lithium	**<0.01**	**0.01**	
Boron	**0.1**	**0.05**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.
2. Boron reagent blanks contained a slight amount of contamination (0.06 mg/L).
3. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).
4. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Anions, EPA 300.0	2019-05-21 10:54 MGB	3201	2019-05-22 15:09 DLS	
2. Hexavalent Chromium, SM 3500-CR B	2019-05-22 16:26 BRW	1142	2019-06-06 09:03 JAE	
3. Mercury, EPA 7470A (SPLP)	2019-05-31 10:40 SGB	3201	2019-06-03 11:34 MRC	
4. Mercury, EPA 7471B	2019-05-31 10:40 SGB	3201	2019-06-03 11:34 MRC	
5. Metals, EPA 6020	2019-05-30 13:29 SGB	3201	2019-06-03 10:53 MRC	
6. Metals, EPA 6020	2019-06-03 09:53 SGB	3201	2019-06-05 21:10 BRW	
7. Metals, EPA 6020	2019-05-29 11:18 SGB	3201	2019-06-03 13:37 MRC	
8. Metals, EPA 6010 D	2019-05-28 09:55 MRC	3201	2019-05-29 11:15 DLS	
9. Synthetic Precipitation Leaching Procedure, EPA 1312	2019-05-15 12:45 KMJ	3201	2019-05-17 09:15 JAE	
10. Metals, EPA 6020	2019-05-29 11:18 SGB	3201	2019-06-03 13:37 MRC	
11. Metals, EPA 6010 D	2019-05-28 09:55 MRC	3201	2019-05-29 11:15 DLS	

Collection Location	Collector	Client Reference	Accession #	
#1_13_e	jackson hylton	ssab harsco	805937	CORRECTED REPORT 1

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/L = Milligrams per Liter
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
#3_12_w	jackson hylton 515/825-8338	ssab harsco	805938 CORRECTED REPORT 1
MUSCATINE,	Collected 2019-05-03 12:33	Received 2019-05-09 15:26	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Anions, EPA 300.0				*4*
Fluoride	**11**	**5**		

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*3*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/L)	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7470A (SPLP)			
Mercury	**<0.002**	**0.002**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Manganese	**5300**	**2**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.9**	**1**	
Barium	**60**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**4.8**	**2**	
Chromium	**430**	**2**	
Cobalt	**<5.0**	**5**	
Lead	**13**	**10**	
Molybdenum	**5.9**	**5**	
Nickel	**29**	**5**	
Selenium	**<5.0**	**5**	
Silver	**1.1**	**1**	
Strontium	**100**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**72**	**5**	
Zinc	**230**	**2**	
Metals, EPA 6020			
Copper	**52**	**5**	
Metals, EPA 6010 D			*2*
Boron	**46**	**5.0**	

Collection Location	Collector	Client Reference	Accession #	
#3_12_w	jackson hylton	ssab harsco	805938	CORRECTED REPORT 1

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Lithium	**3.4**	**1.0**	

TEST	RESULT (mg/L)	QUANT LIMIT	ANALYSIS NOTE(S)
Metals, EPA 6020			
Antimony	**<0.006**	**0.006**	
Arsenic	**<0.01**	**0.01**	
Barium	**<2.0**	**2**	
Beryllium	**<0.004**	**0.004**	
Cobalt	**<0.05**	**0.05**	
Cadmium	**<0.005**	**0.005**	
Chromium	**<0.1**	**0.1**	
Copper	**<1.0**	**1**	
Lead	**<0.015**	**0.015**	
Manganese	**<0.05**	**0.05**	
Molybdenum	**<0.05**	**0.05**	
Nickel	**<0.1**	**0.1**	
Selenium	**<0.05**	**0.05**	
Silver	**<0.1**	**0.1**	
Thallium	**<0.002**	**0.002**	
Vanadium	**<0.05**	**0.05**	
Zinc	**<0.1**	**0.1**	
Metals, EPA 6010 D			
Lithium	**<0.01**	**0.01**	
Boron	**0.07**	**0.05**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.
2. Boron reagent blanks contained a slight amount of contamination (0.06 mg/L).
3. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).
4. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Anions, EPA 300.0	2019-05-21 13:10 MGB	3201	2019-05-22 15:09 DLS	
2. Hexavalent Chromium, SM 3500-CR B	2019-05-22 16:26 BRW	1142	2019-06-06 09:03 JAE	
3. Mercury, EPA 7470A (SPLP)	2019-05-31 10:40 SGB	3201	2019-06-03 11:34 MRC	
4. Mercury, EPA 7471B	2019-05-31 10:40 SGB	3201	2019-06-03 11:34 MRC	
5. Metals, EPA 6020	2019-05-30 13:29 SGB	3201	2019-06-03 10:53 MRC	
6. Metals, EPA 6020	2019-05-29 11:18 SGB	3201	2019-06-03 13:37 MRC	
7. Metals, EPA 6020	2019-06-03 09:53 SGB	3201	2019-06-05 21:10 BRW	
8. Metals, EPA 6010 D	2019-05-28 09:55 MRC	3201	2019-05-29 11:15 DLS	
9. Synthetic Precipitation Leaching Procedure, EPA 1312	2019-05-15 12:45 KMJ	3201	2019-05-17 09:15 JAE	
10. Metals, EPA 6020	2019-05-29 11:18 SGB	3201	2019-06-03 13:37 MRC	
11. Metals, EPA 6010 D	2019-05-28 09:55 MRC	3201	2019-05-29 11:15 DLS	

Collection Location	Collector	Client Reference	Accession #	
#3_12_w	jackson hylton	ssab harsco	805938	CORRECTED REPORT 1

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/L = Milligrams per Liter
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
#5_12_n	jackson hylton 515/825-8338	ssab harsco	805939 CORRECTED REPORT 1
MUSCATINE,	Collected 2019-05-03 12:27	Received 2019-05-09 15:26	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Anions, EPA 300.0				*4*
Fluoride	**6.4**	**5**		

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*3*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/L)	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7470A (SPLP)			
Mercury	**<0.002**	**0.002**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Manganese	**10000**	**2**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.2**	**1**	
Barium	**130**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**6.6**	**2**	
Chromium	**940**	**2**	
Cobalt	**<5.0**	**5**	
Lead	**20**	**10**	
Molybdenum	**11**	**5**	
Nickel	**31**	**5**	
Selenium	**<5.0**	**5**	
Silver	**2**	**1**	
Strontium	**120**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**140**	**5**	
Zinc	**450**	**2**	
Metals, EPA 6020			
Copper	**85**	**5**	
Metals, EPA 6010 D			*2*
Boron	**58**	**5.0**	

Collection Location	Collector	Client Reference	Accession #	
#5_12_n	jackson hylton	ssab harsco	805939	CORRECTED REPORT 1

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Lithium	**5.3**	**1.0**	

TEST	RESULT (mg/L)	QUANT LIMIT	ANALYSIS NOTE(S)
Metals, EPA 6020			
Antimony	**<0.006**	**0.006**	
Arsenic	**<0.01**	**0.01**	
Barium	**<2.0**	**2**	
Beryllium	**<0.004**	**0.004**	
Cadmium	**<0.005**	**0.005**	
Chromium	**<0.1**	**0.1**	
Copper	**<1.0**	**1**	
Lead	**<0.015**	**0.015**	
Manganese	**<0.05**	**0.05**	
Molybdenum	**<0.05**	**0.05**	
Nickel	**<0.1**	**0.1**	
Selenium	**<0.05**	**0.05**	
Silver	**<0.1**	**0.1**	
Thallium	**<0.002**	**0.002**	
Vanadium	**<0.05**	**0.05**	
Zinc	**<0.1**	**0.1**	
Cobalt	**<0.05**	**0.05**	
Metals, EPA 6010 D			
Lithium	**<0.01**	**0.01**	
Boron	**0.11**	**0.05**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.
2. Boron reagent blanks contained a slight amount of contamination (0.06 mg/L).
3. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).
4. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Anions, EPA 300.0	2019-05-21 13:55 MGB	3201	2019-05-22 15:09 DLS	
2. Hexavalent Chromium, SM 3500-CR B	2019-05-22 16:26 BRW	1142	2019-06-06 09:03 JAE	
3. Mercury, EPA 7470A (SPLP)	2019-05-31 10:40 SGB	3201	2019-06-03 11:34 MRC	
4. Mercury, EPA 7471B	2019-05-31 10:40 SGB	3201	2019-06-03 11:34 MRC	
5. Metals, EPA 6020	2019-05-30 13:29 SGB	3201	2019-06-03 10:53 MRC	
6. Metals, EPA 6020	2019-05-29 11:18 SGB	3201	2019-06-03 13:37 MRC	
7. Metals, EPA 6020	2019-06-03 09:53 SGB	3201	2019-06-05 21:10 BRW	
8. Metals, EPA 6010 D	2019-05-28 09:55 MRC	3201	2019-05-29 11:15 DLS	
9. Synthetic Precipitation Leaching Procedure, EPA 1312	2019-05-15 12:45 KMJ	3201	2019-05-17 09:15 JAE	
10. Metals, EPA 6020	2019-05-29 11:18 SGB	3201	2019-06-03 13:37 MRC	
11. Metals, EPA 6010 D	2019-05-28 09:55 MRC	3201	2019-05-29 11:15 DLS	

Collection Location	Collector	Client Reference	Accession #	
#5_12_n	jackson hylton	ssab harsco	805939	CORRECTED REPORT 1

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/L = Milligrams per Liter
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#1_4_w	814888
MUSCATINE,	Collected 2019-05-03 11:34	Received 2019-05-31 14:10	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*2*
Fluoride	**11**	**5**	**4.0**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**3.5**	**1**	
Barium	**180**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**13**	**2**	
Chromium	**1400**	**2**	
Cobalt	**4.3**	**5**	
Copper	**100**	**5**	
Lead	**20**	**10**	
Manganese	**15000**	**2**	
Molybdenum	**15**	**5**	
Nickel	**62**	**5**	
Selenium	**<1.0**	**1**	
Silver	**3.4**	**1**	
Strontium	**140**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**230**	**5**	
Zinc	**570**	**2**	
Metals, EPA 6010 D			
Boron	**75**	**5.0**	
Lithium	**6.7**	**1.0**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#1_4_w	814888

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-07 01:57 MGB	3201	2019-06-10 09:22 JAE	
2. Mercury, EPA 7471B	2019-06-12 10:47 SGB	3201	2019-06-12 14:08 MRC	
3. Metals, EPA 6020	2019-06-06 16:09 SGB	3201	2019-06-10 12:13 MRC	
4. Metals, EPA 6010 D	2019-06-07 09:10 MRC	3201	2019-06-07 16:30 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#1-15-e	814889
MUSCATINE,	Collected 2019-05-03 11:41	Received 2019-05-31 14:10	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*2*
Fluoride	**10**	**5**	**4.0**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.6**	**1**	
Barium	**150**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**11**	**2**	
Chromium	**1100**	**2**	
Cobalt	**4.3**	**5**	
Copper	**83**	**5**	
Lead	**19**	**10**	
Manganese	**11000**	**2**	
Molybdenum	**11**	**5**	
Nickel	**60**	**5**	
Selenium	**<1.0**	**1**	
Silver	**2.2**	**1**	
Strontium	**130**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**200**	**5**	
Zinc	**500**	**2**	
Metals, EPA 6010 D			
Boron	**65**	**5.0**	
Lithium	**5.8**	**1.0**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#1-15-e	814889

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-07 04:13 MGB	3201	2019-06-10 09:22 JAE	
2. Mercury, EPA 7471B	2019-06-12 10:47 SGB	3201	2019-06-12 14:08 MRC	
3. Metals, EPA 6020	2019-06-06 16:09 SGB	3201	2019-06-10 12:13 MRC	
4. Metals, EPA 6010 D	2019-06-07 09:10 MRC	3201	2019-06-07 16:30 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#1-19-ne	814890
MUSCATINE,	Collected 2019-05-03 11:45	Received 2019-05-31 14:10	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*2*
Fluoride	**7.4**	**5**	**4.0**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.5**	**1**	
Barium	**130**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**10**	**2**	
Chromium	**910**	**2**	
Cobalt	**4.1**	**5**	
Copper	**69**	**5**	
Lead	**18**	**10**	
Manganese	**11000**	**2**	
Molybdenum	**10**	**5**	
Nickel	**56**	**5**	
Selenium	**<1.0**	**1**	
Silver	**2.2**	**1**	
Strontium	**120**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**160**	**5**	
Zinc	**310**	**2**	
Metals, EPA 6010 D			
Boron	**62**	**5.0**	
Lithium	**12**	**1.0**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#1-19-ne	814890

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-07 04:58 MGB	3201	2019-06-10 09:22 JAE	
2. Mercury, EPA 7471B	2019-06-12 10:47 SGB	3201	2019-06-12 14:08 MRC	
3. Metals, EPA 6020	2019-06-06 16:09 SGB	3201	2019-06-10 12:13 MRC	
4. Metals, EPA 6010 D	2019-06-07 09:10 MRC	3201	2019-06-07 16:30 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#5-1-se	814891
MUSCATINE,	Collected 2019-05-03 12:13	Received 2019-05-31 14:10	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*2*
Fluoride	**12**	**5**	**4.0**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.4**	**1**	
Barium	**130**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**9.1**	**2**	
Chromium	**950**	**2**	
Cobalt	**3.1**	**5**	
Copper	**73**	**5**	
Lead	**17**	**10**	
Manganese	**11000**	**2**	
Molybdenum	**9.7**	**5**	
Nickel	**33**	**5**	
Selenium	**<1.0**	**1**	
Silver	**2.1**	**1**	
Strontium	**120**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**150**	**5**	
Zinc	**340**	**2**	
Metals, EPA 6010 D			
Boron	**62**	**5.0**	
Lithium	**5.2**	**1.0**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#5-1-se	814891

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-07 05:44 MGB	3201	2019-06-10 09:22 JAE	
2. Mercury, EPA 7471B	2019-06-12 10:47 SGB	3201	2019-06-12 14:08 MRC	
3. Metals, EPA 6020	2019-06-06 16:09 SGB	3201	2019-06-10 12:13 MRC	
4. Metals, EPA 6010 D	2019-06-07 09:10 MRC	3201	2019-06-07 16:30 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#2-1-se	822826
MUSCATINE,	Collected 2019-05-03 11:35	Received 2019-06-18 16:08	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**4.6**	**2**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**3.4**	**1**	
Barium	**83**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**2.7**	**2**	
Chromium	**500**	**2**	
Cobalt	**<5.0**	**5**	
Copper	**39**	**5**	
Lead	**13**	**10**	
Manganese	**4000**	**2**	
Molybdenum	**7.2**	**5**	
Nickel	**30**	**5**	
Selenium	**<1.0**	**1**	
Silver	**<1.0**	**1**	
Strontium	**110**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**65**	**5**	
Zinc	**140**	**2**	
Metals, EPA 6010 D			
Boron	**31**	**5.0**	
Lithium	**3.6**	**1.0**	

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#2-1-se	822826

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-21 04:44 MGB	3201	2019-06-24 10:04 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-06-21 15:04 BRW	1142	2019-07-05 09:54 JAE	
3. Mercury, EPA 7471B	2019-06-27 11:16 SGB	3201	2019-07-01 10:13 BRW	
4. Metals, EPA 6020	2019-06-26 14:20 SGB	3201	2019-06-28 13:03 BRW	
5. Metals, EPA 6010 D	2019-06-24 14:50 MRC	3201	2019-06-27 13:06 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#2-6-w	822827
MUSCATINE,	Collected 2019-05-03 11:09	Received 2019-06-18 16:08	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**12**	**2**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**3.3**	**1**	
Barium	**130**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**6.8**	**2**	
Chromium	**620**	**2**	
Cobalt	**<5.0**	**5**	
Copper	**55**	**5**	
Lead	**29**	**10**	
Manganese	**5900**	**2**	
Molybdenum	**7.9**	**5**	
Nickel	**33**	**5**	
Selenium	**<1.0**	**1**	
Silver	**1.7**	**1**	
Strontium	**120**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**100**	**5**	
Zinc	**420**	**2**	
Metals, EPA 6010 D			
Boron	**38**	**5.0**	
Lithium	**5.7**	**1.0**	

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#2-6-w	822827

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-21 07:00 MGB	3201	2019-06-24 10:04 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-06-21 15:04 BRW	1142	2019-07-05 09:54 JAE	
3. Mercury, EPA 7471B	2019-06-27 11:16 SGB	3201	2019-07-01 10:13 BRW	
4. Metals, EPA 6020	2019-06-26 14:20 SGB	3201	2019-06-28 13:03 BRW	
5. Metals, EPA 6010 D	2019-06-24 14:50 MRC	3201	2019-06-27 13:06 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#2-20-nw	822828
MUSCATINE,	Collected: 2019-05-03 11:19	Received: 2019-06-18 16:08	Project: wmsf

Report To:
HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**5**	**2**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**4.2**	**1**	
Barium	**180**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**12**	**2**	
Chromium	**1000**	**2**	
Cobalt	**<5.0**	**5**	
Copper	**110**	**5**	
Lead	**48**	**10**	
Manganese	**9600**	**2**	
Molybdenum	**17**	**5**	
Nickel	**63**	**5**	
Selenium	**<1.0**	**1**	
Silver	**3.4**	**1**	
Strontium	**150**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**160**	**5**	
Zinc	**870**	**2**	
Metals, EPA 6010 D			
Boron	**70**	**5.0**	
Lithium	**9.1**	**1.0**	

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#2-20-nw	822828

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-21 07:46 MGB	3201	2019-06-24 10:04 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-06-21 15:04 BRW	1142	2019-07-05 09:54 JAE	
3. Mercury, EPA 7471B	2019-06-27 11:16 SGB	3201	2019-07-01 10:13 BRW	
4. Metals, EPA 6020	2019-06-26 14:20 SGB	3201	2019-06-28 13:03 BRW	
5. Metals, EPA 6010 D	2019-06-24 14:50 MRC	3201	2019-06-27 13:06 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#3-2-sw	822829
MUSCATINE,	Collected 2019-05-03 12:28	Received 2019-06-18 16:08	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**8.6**	**2**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**3.3**	**1**	
Barium	**100**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**6.1**	**2**	
Chromium	**760**	**2**	
Cobalt	**<5.0**	**5**	
Copper	**44**	**5**	
Lead	**15**	**10**	
Manganese	**7100**	**2**	
Molybdenum	**7.2**	**5**	
Nickel	**32**	**5**	
Selenium	**<1.0**	**1**	
Silver	**1.4**	**1**	
Strontium	**120**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**120**	**5**	
Zinc	**230**	**2**	
Metals, EPA 6010 D			
Boron	**49**	**5.0**	
Lithium	**4.2**	**1.0**	

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#3-2-sw	822829

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-21 08:31 MGB	3201	2019-06-24 10:04 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-06-21 15:04 BRW	1142	2019-07-05 09:54 JAE	
3. Mercury, EPA 7471B	2019-06-27 11:16 SGB	3201	2019-07-01 10:13 BRW	
4. Metals, EPA 6020	2019-06-26 14:20 SGB	3201	2019-06-28 13:03 BRW	
5. Metals, EPA 6010 D	2019-06-24 14:50 MRC	3201	2019-06-27 13:06 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#3-2-sw df	822830
MUSCATINE,	Collected: 2019-05-03 12:27	Received: 2019-06-18 16:08	Project: wmsf

Report To:
HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**8.6**	**2**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**1.5**	**1**	
Barium	**80**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**6.6**	**2**	
Chromium	**520**	**2**	
Cobalt	**<5.0**	**5**	
Copper	**40**	**5**	
Lead	**14**	**10**	
Manganese	**5700**	**2**	
Molybdenum	**5.8**	**5**	
Nickel	**30**	**5**	
Selenium	**<1.0**	**1**	
Silver	**1.6**	**1**	
Strontium	**110**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**84**	**5**	
Zinc	**210**	**2**	
Metals, EPA 6010 D			
Boron	**43**	**5.0**	
Lithium	**4.2**	**1.0**	

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#3-2-sw df	822830

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-21 09:16 MGB	3201	2019-06-24 10:04 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-06-21 15:04 BRW	1142	2019-07-05 09:54 JAE	
3. Mercury, EPA 7471B	2019-06-27 11:16 SGB	3201	2019-07-01 10:13 BRW	
4. Metals, EPA 6020	2019-06-26 14:20 SGB	3201	2019-06-28 13:03 BRW	
5. Metals, EPA 6010 D	2019-06-24 14:50 MRC	3201	2019-06-27 13:06 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#3-9- e	822831
MUSCATINE,	Collected: 2019-05-03 12:23	Received: 2019-06-18 16:08	Project: wmsf

Report To:
HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**8.6**	**2**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**1.6**	**1**	
Barium	**67**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**5.8**	**2**	
Chromium	**390**	**2**	
Cobalt	**<5.0**	**5**	
Copper	**34**	**5**	
Lead	**11**	**10**	
Manganese	**4700**	**2**	
Molybdenum	**5.1**	**5**	
Nickel	**27**	**5**	
Selenium	**<1.0**	**1**	
Silver	**1.2**	**1**	
Strontium	**110**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**81**	**5**	
Zinc	**140**	**2**	
Metals, EPA 6010 D			
Boron	**41**	**5.0**	
Lithium	**3.5**	**1.0**	

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#3-9- e	822831

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-21 10:02 MGB	3201	2019-06-24 10:04 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-06-21 15:04 BRW	1142	2019-07-05 09:54 JAE	
3. Mercury, EPA 7471B	2019-06-27 11:16 SGB	3201	2019-07-01 10:13 BRW	
4. Metals, EPA 6020	2019-06-26 14:20 SGB	3201	2019-06-28 13:03 BRW	
5. Metals, EPA 6010 D	2019-06-24 14:50 MRC	3201	2019-06-27 13:06 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	#3-16-w	822832
MUSCATINE,	Collected 2019-05-03 12:35	Received 2019-06-18 16:08	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**10**	**2**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.5**	**1**	
Barium	**97**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**8.1**	**2**	
Chromium	**630**	**2**	
Cobalt	**<5.0**	**5**	
Copper	**63**	**5**	
Lead	**16**	**10**	
Manganese	**7100**	**2**	
Molybdenum	**6.9**	**5**	
Nickel	**34**	**5**	
Selenium	**<1.0**	**1**	
Silver	**1.7**	**1**	
Strontium	**120**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**100**	**5**	
Zinc	**260**	**2**	
Metals, EPA 6010 D			
Boron	**50**	**5.0**	
Lithium	**4.3**	**1.0**	

Collection Location	Collector	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton	#3-16-w	822832

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-06-21 10:47 MGB	3201	2019-06-24 10:04 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-06-21 15:04 BRW	1142	2019-07-05 09:54 JAE	
3. Mercury, EPA 7471B	2019-06-27 11:16 SGB	3201	2019-07-01 10:13 BRW	
4. Metals, EPA 6020	2019-06-26 14:20 SGB	3201	2019-06-28 13:03 BRW	
5. Metals, EPA 6010 D	2019-06-24 14:50 MRC	3201	2019-06-27 13:06 BRW	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
#10-1-se SSAB/HARSCO/MUSCATINE MUSCATINE,	jackson hylton 515/725-8338		830644 CORRECTED REPORT 1
	Collected	**Received**	**Project**
	2019-07-02 10:50	2019-07-08 12:12	wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**<1.0**	**1**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**1.3**	**1**	
Barium	**15**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**<2.0**	**2**	
Chromium	**4.4**	**2**	
Iron	**4800**	**2**	
Lead	**<10**	**10**	
Manganese	**1400**	**2**	
Mercury	**<1.0**	**1**	
Molybdenum	**<5.0**	**5**	
Nickel	**19**	**5**	
Selenium	**<1.0**	**1**	
Silver	**<1.0**	**1**	
Strontium	**120**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**<5.0**	**5**	
Zinc	**25**	**2**	
Metals, EPA 6010 D			
Boron	**13**	**5.0**	
Lithium	**1.5**	**1.0**	

Collection Location	Collector	Client Reference	Accession #	
#10-1-se	jackson hylton		830644	CORRECTED REPORT 1

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-07-24 08:55 MGB	3201	2019-07-25 07:51 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-07-18 16:00 BRW	1142	2019-07-26 16:11 DLS	
3. Mercury, EPA 7471B	2019-07-16 10:12 SGB	3201	2019-07-16 15:53 MRC	
4. Metals, EPA 6020	2019-07-16 13:04 SGB	3201	2019-07-17 15:39 MRC	
5. Metals, EPA 6010 D	2019-07-23 09:37 MRC	3201	2019-07-23 16:33 DLS	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
#10-4-n SSAB/HARSCO/MUSCATINE MUSCATINE,	jackson hylton 515/725-8338		830645 CORRECTED REPORT 1
	Collected	**Received**	**Project**
	2019-07-02 10:46	2019-07-08 12:12	wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**1.1**	**1**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2**	**1**	
Barium	**29**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**<2.0**	**2**	
Chromium	**5.6**	**2**	
Iron	**5700**	**2**	
Lead	**<10**	**10**	
Manganese	**2400**	**2**	
Mercury	**<1.0**	**1**	
Molybdenum	**<5.0**	**5**	
Nickel	**41**	**5**	
Selenium	**<1.0**	**1**	
Silver	**<1.0**	**1**	
Strontium	**170**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**6.1**	**5**	
Zinc	**29**	**2**	
Metals, EPA 6010 D			
Boron	**17**	**5.0**	
Lithium	**2.7**	**1.0**	

Collection Location	Collector	Client Reference	Accession #	
#10-4-n	jackson hylton		830645	CORRECTED REPORT 1

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-07-24 10:28 MGB	3201	2019-07-25 07:51 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-07-18 16:00 BRW	1142	2019-07-26 16:11 DLS	
3. Mercury, EPA 7471B	2019-07-16 10:12 SGB	3201	2019-07-16 15:53 MRC	
4. Metals, EPA 6020	2019-07-16 13:04 SGB	3201	2019-07-17 15:39 MRC	
5. Metals, EPA 6010 D	2019-07-23 09:37 MRC	3201	2019-07-23 16:33 DLS	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
#10-5-s SSAB/HARSCO/MUSCATINE MUSCATINE,	jackson hylton 515/725-8338		830646 CORRECTED REPORT 1
	Collected	**Received**	**Project**
	2019-07-02 10:41	2019-07-08 12:12	wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description
soil

Sample Type
Solid

Sample Source

Sample Note(s)
1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**<1.0**	**1**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**1.1**	**1**	
Barium	**12**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**<2.0**	**2**	
Chromium	**3.9**	**2**	
Iron	**4200**	**2**	
Lead	**<10**	**10**	
Manganese	**1300**	**2**	
Mercury	**<1.0**	**1**	
Molybdenum	**<5.0**	**5**	
Nickel	**20**	**5**	
Selenium	**1.1**	**1**	
Silver	**<1.0**	**1**	
Strontium	**130**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**<5.0**	**5**	
Zinc	**40**	**2**	
Metals, EPA 6010 D			
Boron	**12**	**5.0**	
Lithium	**1.2**	**1.0**	

Collection Location	Collector	Client Reference	Accession #	
#10-5-s	jackson hylton		830646	CORRECTED REPORT 1

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-07-24 10:59 MGB	3201	2019-07-25 07:51 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-07-18 16:00 BRW	1142	2019-07-26 16:11 DLS	
3. Mercury, EPA 7471B	2019-07-16 10:12 SGB	3201	2019-07-16 15:53 MRC	
4. Metals, EPA 6020	2019-07-16 13:04 SGB	3201	2019-07-17 15:39 MRC	
5. Metals, EPA 6010 D	2019-07-23 09:37 MRC	3201	2019-07-23 16:33 DLS	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
#10-10-nw SSAB/HARSCO/MUSCATINE MUSCATINE,	jackson hylton 515/725-8338		830647 CORRECTED REPORT 1
	Collected	**Received**	**Project**
	2019-07-02 10:35	2019-07-08 12:12	wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description
soil

Sample Type
Solid

Sample Source

Sample Note(s)
1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**<1.0**	**1**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**1.9**	**1**	
Barium	**16**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**<2.0**	**2**	
Chromium	**3.8**	**2**	
Iron	**4700**	**2**	
Lead	**<10**	**10**	
Manganese	**2600**	**2**	
Mercury	**<1.0**	**1**	
Molybdenum	**<5.0**	**5**	
Nickel	**45**	**5**	
Selenium	**1.1**	**1**	
Silver	**<1.0**	**1**	
Strontium	**200**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**<5.0**	**5**	
Zinc	**13**	**2**	
Metals, EPA 6010 D			
Boron	**14**	**5.0**	
Lithium	**2.1**	**1.0**	

Collection Location	Collector	Client Reference	Accession #	
#10-10-nw	jackson hylton		830647	CORRECTED REPORT 1

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-07-24 11:30 MGB	3201	2019-07-25 07:51 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-07-18 16:00 BRW	1142	2019-07-26 16:11 DLS	
3. Mercury, EPA 7471B	2019-07-16 10:12 SGB	3201	2019-07-16 15:53 MRC	
4. Metals, EPA 6020	2019-07-16 13:04 SGB	3201	2019-07-17 15:39 MRC	
5. Metals, EPA 6010 D	2019-07-23 09:37 MRC	3201	2019-07-23 16:33 DLS	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
#10-10-nw-fd SSAB/HARSCO/MUSCATINE MUSCATINE,	jackson hylton 515/725-8338		830648 CORRECTED REPORT 1
	Collected 2019-07-02 10:36	**Received** 2019-07-08 12:12	**Project** wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description
soil

Sample Type
Solid

Sample Source

Sample Note(s)
1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**<1.0**	**1**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.3**	**1**	
Barium	**20**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**<2.0**	**2**	
Chromium	**3.6**	**2**	
Iron	**5100**	**2**	
Lead	**<10**	**10**	
Manganese	**2500**	**2**	
Mercury	**<1.0**	**1**	
Molybdenum	**<5.0**	**5**	
Nickel	**46**	**5**	
Selenium	**1.2**	**1**	
Silver	**<1.0**	**1**	
Strontium	**190**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**<5.0**	**5**	
Zinc	**55**	**2**	
Metals, EPA 6010 D			
Boron	**13**	**5.0**	
Lithium	**1.9**	**1.0**	

Collection Location	Collector	Client Reference	Accession #	
#10-10-nw-fd	jackson hylton		830648	CORRECTED REPORT 1

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-07-24 12:01 MGB	3201	2019-07-25 07:51 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-07-18 16:00 BRW	1142	2019-07-26 16:11 DLS	
3. Mercury, EPA 7471B	2019-07-16 10:12 SGB	3201	2019-07-16 15:53 MRC	
4. Metals, EPA 6020	2019-07-16 13:04 SGB	3201	2019-07-17 15:39 MRC	
5. Metals, EPA 6010 D	2019-07-23 09:37 MRC	3201	2019-07-23 16:33 DLS	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
1333-holly-e SSAB/HARSCO/MUSCATINE MUSCATINE,	jackson hylton 515/725-8338		830649 CORRECTED REPORT 1
	Collected	**Received**	**Project**
	2019-07-02 11:29	2019-07-08 12:12	wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**8.3**	**1**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020			
Antimony	**<5.0**	**5**	
Arsenic	**2.6**	**1**	
Barium	**260**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**9.3**	**2**	
Chromium	**2100**	**2**	
Lead	**40**	**10**	
Manganese	**19000**	**2**	
Mercury	**<1.0**	**1**	
Molybdenum	**20**	**5**	
Nickel	**40**	**5**	
Selenium	**1.5**	**1**	
Silver	**3.8**	**1**	
Strontium	**170**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**340**	**5**	
Zinc	**450**	**2**	
Metals, EPA 6010 D			
Boron	**95**	**5.0**	
Lithium	**8.2**	**1.0**	
Metals, EPA 6010 D			
Iron	**110000**	**2.0**	

Collection Location	Collector	Client Reference	Accession #	
1333-holly-e	jackson hylton		830649	CORRECTED REPORT 1

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-07-24 12:31 MGB	3201	2019-07-25 07:51 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-07-18 16:00 BRW	1142	2019-07-26 16:11 DLS	
3. Mercury, EPA 7471B	2019-07-16 10:12 SGB	3201	2019-07-16 15:53 MRC	
4. Metals, EPA 6020	2019-07-16 13:04 SGB	3201	2019-07-17 15:39 MRC	
5. Metals, EPA 6010 D	2019-07-23 09:37 MRC	3201	2019-07-23 16:33 DLS	
6. Metals, EPA 6010 D	2019-07-17 11:00 MRC	3201	2019-07-19 09:07 DLS	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
1333-holly-w SSAB/HARSCO/MUSCATINE MUSCATINE,	jackson hylton 515/725-8338		830650 CORRECTED REPORT 1
	Collected	**Received**	**Project**
	2019-07-02 11:30	2019-07-08 12:12	wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description
soil

Sample Type
Solid

Sample Source

Sample Note(s)
1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [recd wt])	QUANT LIMIT	MCL	ANALYSIS NOTE(S)
Fluoride, EPA 300.0				*3*
Fluoride	**6.6**	**1**	**4.0**	

TEST	RESULT (mg/kg)	QUANT LIMIT	ANALYSIS NOTE(S)
Hexavalent Chromium, SM 3500-CR B			*2*
Hexavalent chromium	**<1.0**	**1**	

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Mercury, EPA 7471B			
Mercury	**<1.0**	**1**	
Metals, EPA 6020		*CORRECTED REPORT 1*	
Antimony	**<5.0**	**5**	
Arsenic	**2.6**	**1**	
Barium	**160**	**5**	
Beryllium	**<2.0**	**2**	
Cadmium	**6.3**	**2**	
Chromium	**1100**	**2**	
Lead	**29**	**10**	
Manganese	**12000**	**2**	
Mercury	**<1.0**	**1**	
Molybdenum	**13**	**5**	
Nickel	**34**	**5**	
Selenium	**1.5**	**1**	
Silver	**1.9**	**1**	
Strontium	**150**	**2**	
Thallium	**<1.0**	**1**	
Tin	**<10**	**10**	
Vanadium	**200**	**5**	
Zinc	**310**	**2**	
Metals, EPA 6010 D			
Boron	**62**	**5.0**	
Lithium	**6.3**	**1.0**	
Metals, EPA 6010 D			
Iron	**69000**	**2.0**	

Collection Location	Collector	Client Reference	Accession #	
1333-holly-w	jackson hylton		830650	CORRECTED REPORT 1

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

2. Analytical test performed by QC Analytical Services, LLC, LeClaire, IA (Iowa Lab ID #113).

3. The MCL (maximum contaminant level) is only applicable to compliance monitoring samples under the Safe Drinking Water Act (SDWA).

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Fluoride, EPA 300.0	2019-07-24 13:02 MGB	3201	2019-07-25 07:51 JAE	
2. Hexavalent Chromium, SM 3500-CR B	2019-07-18 16:00 BRW	1142	2019-07-26 16:11 DLS	
3. Mercury, EPA 7471B	2019-07-16 10:12 SGB	3201	2019-07-16 15:53 MRC	
4. Metals, EPA 6020	2019-07-16 13:04 SGB	3201	2019-07-19 09:12 MRC	
5. Metals, EPA 6010 D	2019-07-23 09:37 MRC	3201	2019-07-23 16:33 DLS	
6. Metals, EPA 6010 D	2019-07-17 11:00 MRC	3201	2019-07-19 09:07 DLS	

DESCRIPTION OF UNITS

mg/kg [recd wt] = Milligrams per Kilogram as Received
mg/kg = Milligrams per Kilogram
mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

1142 QC ANALYTICAL SERVICES LLC, 1798 IOWA DR, LE CLAIRE, IA 52753-0745;

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	e-1	843796
MUSCATINE,	Collected 2019-07-02 11:29	Received 2019-08-02 11:25	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Metals, EPA 6020			
Arsenic	**2.1**	**1**	
Cadmium	**12**	**2**	
Iron	**94500**	**2**	
Manganese	**12000**	**2**	
Vanadium	**180**	**5**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Metals, EPA 6020	2019-08-07 09:53 SGB	3201	2019-08-07 14:20 MRC	

DESCRIPTION OF UNITS

mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	e-2	843797
MUSCATINE,	Collected 2019-07-02 11:29	Received 2019-08-02 11:25	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Metals, EPA 6020			
Arsenic	**2**	**1**	
Cadmium	**10**	**2**	
Iron	**69100**	**2**	
Manganese	**9100**	**2**	
Vanadium	**170**	**5**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Metals, EPA 6020	2019-08-07 09:53 SGB	3201	2019-08-07 14:20 MRC	

DESCRIPTION OF UNITS

mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	w-1	843798
MUSCATINE,	Collected 2019-07-02 11:30	Received 2019-08-02 11:25	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Metals, EPA 6020			
Arsenic	**1.6**	**1**	
Cadmium	**8.7**	**2**	
Iron	**60100**	**2**	
Manganese	**7900**	**2**	
Vanadium	**140**	**5**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Metals, EPA 6020	2019-08-07 09:53 SGB	3201	2019-08-07 14:20 MRC	

DESCRIPTION OF UNITS

mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Collection Location	Collector and Phone	Client Reference	Accession #
ssab/harsco/muscatine ss	jackson hylton 515/725-8338	w-2	843799
MUSCATINE,	Collected 2019-07-02 11:30	Received 2019-08-02 11:25	Project wmsf

Report To

HYLTON JACKSON
IDNR CONTAMINATED SITES
LAND QUALITY BUREAU
502 E 9TH ST
DES MOINES, IA 50319-0034

Sample Description: soil
Sample Type: Solid
Sample Source:
Sample Note(s): 1

RESULTS OF ANALYSIS - FINAL REPORT

TEST	RESULT (mg/kg [dry wt])	QUANT LIMIT	ANALYSIS NOTE(S)
Metals, EPA 6020			
Arsenic	**2.1**	**1**	
Cadmium	**7.3**	**2**	
Iron	**47900**	**2**	
Manganese	**6700**	**2**	
Vanadium	**140**	**5**	

SAMPLE AND ANALYSIS NOTES

1. Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

ANALYSIS INFORMATION

TEST	ANALYZED	SITE	RELEASED	ANALYSIS PREP
1. Metals, EPA 6020	2019-08-07 09:53 SGB	3201	2019-08-07 14:20 MRC	

DESCRIPTION OF UNITS

mg/kg [dry wt] = Milligrams per Kilogram by Dry Weight

SITE(S) PERFORMING TESTING

3201 STATE HYGIENIC LABORATORY ANKENY, IOWA LABORATORIES COMPLEX, 2220 S ANKENY BLVD, ANKENY, IA 50023; Phone 515/725-1600; Fax 515/725-1642; Susie Yuan Dai, Ph.D., Associate Director; Wade K. Aldous, Ph.D. (D)ABMM, Associate Director; IOWA ENVIRONMENTAL LAB ID #397

Appendix B

Screen Shot of Output of the Unpaved Road PM10 Predictor