Stratus Redtail Ranch
2259 County Road 5, Erie, CO

Site Map

	Figure 1	12/4/2017
	DE0302	**DRAFT**

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APPENDIX A

FIELD STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE NO. 100

DRUM SAMPLING

Prepared by:____Chris Pracheil_____ Date: ____07 Nov. 2017_

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

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STANDARD OPERATING PROCEDURE NO. 019

DRUM SAMPLING

1.0 INTRODUCTION

Sampling of drums shall be conducted to characterize the contents for off-site disposal. While this SOP applies in general to any drums encountered during the DRWP, the only drums anticipated to be handled are those buried in the Buried Drum Area 1 (BDA 1) and Buried Drum Area 2 (BDA 2) identified in Figure 1 of the DRWP.

The following equipment and supplies may be used during drum sampling:

- field logbook;
- Photoionization Ionization Detector (PID);
- non-sparking drum wrench;
- non-sparking mallet and chisel;
- remotely operated non-sparking punch or other device to open drums suspected of having a volatile or reactive nature;
- stainless steel hand probe, spoon, or spatula (for solids samples);
- syringe for VOC samples;
- stainless steel bowl;
- glass thieving tubes or bailers;
- sample containers;
- decontamination supplies; and
- digital camera.

Sampling of drums with known and unknown contents may be required during field investigations. The sampling procedure for each circumstance will be the same; however, the preliminary drum identification and opening procedures will differ, as may the required PPE. The drum sampling procedures listed below shall be conducted

only within the temporary drum staging area which will be designed as part of the Drum Removal Plan.

2.0 DRUMS WITH KNOWN CONTENTS

When sampling a drum of known contents, the following drum opening and sampling procedures shall be in accordance with the Contractors SOPs, though should include the following

1. Accurately and completely fill out the attached drum inventory log during assessment and sampling of the drum. The drum identification number on the log will key the drum inventory database to the chain of custody, and therefore, to the drum sample database.

2. Photograph the drum to document its condition and any labels or markings. Additionally, note details of markings on the drum log in case photographs are not sufficiently legible.

3. Before opening the drum, segregate the drum as liquid or solid or unstable/reactive, if known and if the drum can be moved without threat of a rupture (see “Drums With Unknown Contents" below).

4. Before opening the drum, ground it electrically to avoid sparking.

5. Loosen the cover or bung of the drum and scan the drum headspace with a PID . If opening the cover, only crack the cover and place the tip of the instrument inside the drum. Record the measurements on the drum log.

6. If PID , support the level of PPE used, remove the drum cover and record the measurements on the drum log.

7. Material from the drum shall be collected using a stainless steel hand probe or a stainless steel spoon (for solids) or a disposable bailer (for liquids). Collection of a hand probe sample is the preferred collection method for drummed solids.

8. For a liquid sample, place the tube or bailer into the center of the drum to collect the sample. Withdraw the sampler, and pour liquids directly into the appropriate sample containers. Seal and label containers. If additional volume is required, repeat the process. Return unused liquid to the drum.

9. For a solids sample, advance the hand probe into the center of the drum to collect the core. Collection of the drum core should be from the 0.5 to 2.5 foot interval below the surface of the material. Withdraw the sampling device from the drum.

10. Gently remove solids from the hand probe, and screen for VOCs (using a PID). Record the measurements in a field log.

11. Select the portion of the drum core with the highest PID reading for VOC analysis (if required), and place in the appropriate sample container. Seal and label sample container.

12. Mix the remaining sample thoroughly using a clean stainless steel bowl and spoon. Fill the remaining sample containers, then seal and label the containers.

13. If additional volume is needed to fill the required sample containers, repeat steps 5 through 8. If a portion of the collected drum core is unused, return the soil to the drum.

14. Immediately after the samples are collected, check sample labels for completeness and initiate Chain of Custody procedures. Place samples in coolers for sample shipment.

15. Decontaminate the sampling equipment (see SOP No. 600).

16. Place drum in overpack and label the overpack with the drum identification number or combine drum contents with other compatible contents, as specified in the task-specific work plan.

3.0 DRUMS WITH UNKNOWN CONTENTS

The procedure for sampling a drum of unknown contents is the same; however, a higher level of PPE and initial external monitoring may be required for opening of the drum. Additionally, if the drum shows evidence of pressurization (i.e., bulging) remote opening techniques may be used and additional health and safety measures may be implemented (e.g., installation of an explosion barrier). Opening of these drums will necessitate the coordination of Site personnel, the Contractor's Project Manager, and health and safety personnel. Extreme caution is required in opening unknown drums,

and all procedures in the HASP as well as the contractor's HASP must be strictly adhered to. Additional discussion pertaining to the health and safety of drum sampling is provided in the HASP. A summary is provided below.

Prior to handling an unknown drum, the following preliminary classification checklist will be reviewed and each response noted in a field notebook:

1. Does the drum contain markings which would indicate that the contents are potentially explosive?

2. Does the drum exhibit leakage or deterioration (i.e., is it sound, does the drum appear to be empty)?

3. Does the drum exhibit apparent internal pressure?

The results of the preliminary inspection will dictate which specific procedures shall be followed in the handling of the drum. The inspection will place each drum in one of three categories: sealed, deteriorated, or drums requiring special handling.

3.1 Sealed Drum Handling

Drums that are sealed, sound and intact and apparently containing material that is not pressurized or potentially explosive will be placed in an overpack and transported to the staging area until they can be opened and the contents sampled as described above. Sealed drums which exhibit bulging indicating internal pressure build-up shall be opened in place, if possible, prior to moving the drum to the staging area. Extreme care shall be exercised when working with and adjacent to potentially pressurized drums. Extra shielding and personnel protection shall be put in place when working with such drums. Special precautions shall be taken to limit and confine any leakage from the drum, which may result from the operation. The drum shall be opened remotely. The drum shall be overpacked or the contents transferred to a new container prior to moving the drum to the staging area. Should movement of a pressurized drum be unavoidable, handling shall only occur by a grappler and/or sling unit constructed for explosive containment.

3.2 Open and Deteriorated Drum Handling

All open drums will be examined to identify contents. Drums that meet the criteria for being considered empty by Resource Conservation and Recovery Act (RCRA) criteria (i.e., less than one inch of residue) will be staged with other debris.

A drum that contains liquids, other than rain water, and exhibits leakage or apparent deterioration such that movement is likely to cause rupture, must have its contents transferred to a new container before the drum is disturbed. Each drum that contains liquids shall be checked with a combustible gas indicator (CGI) for the existence of a potentially explosive atmosphere. If the CGI indicates that the drum atmosphere does not pose an explosion risk, the drum shall also be screened with a (PID) for VOC vapors.

Following the steps described above, drums containing solid or liquid material shall be placed in over-pack containers.

STANDARD OPERATING PROCEDURE NO. 200

SOIL / SLUDGE SAMPLING

Prepared by:____Chris Pracheil_____Date:_07 Nov. 2017

Reviewed by:_____ Date:_____

Approved by:_____ Date:_____

SOP No. 200

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STANDARD OPERATING PROCEDURE NO. 200
SOIL SAMPLING

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the logistics, collection techniques, and documentation requirements for collecting surface soil samples. The soil sampling record to be used during field activities is provided with this SOP.

This SOP will be implemented in accordance with the following governing documents:

- Removal Action Work Plan (RAWP), which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the RAWP;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objective of surface soil sampling (soil samples between ground surface and 36 inches below land surface) is to obtain a representative sample of soil for laboratory analysis. Analytical data will be used to develop potential disposal options. This objective requires that the sample be both free of unsuitable material and be of sufficient quantity and quality for analysis by the selected analytical method.

1.3 Equipment

The following equipment is needed for surface soil sampling:

- Personal Protective Equipment (PPE) as specified in the HASP.
- Sample containers as specified in the FSP and QAPP. Note that samples that are to be analyzed for volatile organic compounds (VOCs) will be collected by the USEPA 5035 Method using the following glassware: one (1) 40 mL VOC vial pre-preserved with 15 mL of methanol, and two (2) 40 mL VOC vials pre-preserved with 5 mL of sodium disulfate. All samples submitted for VOC analysis will also include one small (40 mL to 4 oz) container, to allow the laboratory to record the moisture/dry-weight characteristics.
- Wooden stakes and spray paint (highly visible) or survey pins.
- Field log book and soil sample form (included in SOP) per FSP requirements.
- Sample bottle labels/tags.
- Chain-of-custody forms.
- Hand auger.
- Stainless steel spoon.
- Stainless steel mixing bowl.
- Disposable syringe for VOC sampling.
- Digital scale (accurate to +/- 0.1 grams).
- Indelible marking pens.

2. PROCEDURES

The following procedure should be used for surface soil sampling.

1. Don PPE per the HASP.

2. All surface debris should be removed prior to sampling including wood, paper, sod, gravel, and trash. Identify the sample location and mark with a stake, flagging, or similar marker.
3. Collect the soil using a stainless hand auger. Samples will be collected from a depth of 0-1.0 feet, 1.0-2.0 feet, and 2.0-3.0 feet below land surface. Avoid collection of larger pieces of material (e.g., cobbles, larger rocks). If a matted root zone is present at the sample location, it should be removed prior to sample collection.
4. A pre-cleaned stainless steel spoon or spatula should be used to take the soil sample and fill the sample containers except in the case of a sample for VOC analysis, which is collected using an open-barrel disposable syringe. Care should be taken to avoid sampling anything but soil. Stones, gravel, or vegetation should be removed from the sample since these materials will not be analyzed.
5. For VOC analysis prior to collecting the sample, USEPA Method 5035 specified preservative (5 mL reagent grade water for low level analysis and 15 mL methanol for high level analysis) will be added to 40 mL containers. Each pre-preserved container will then be weighed prior to sample collection, and the container/preservative weight will be recorded on the chain of custody. A digital scale capable of +/- 0.1 gram(s) accuracy will be used to weigh the sample containers in the field.
6. If a sample for VOC is desired it will be collected first using an open barrel, disposable syringe. VOC samples should **never** be homogenized or composited.
7. For a Low Level Analysis the soil will be extruded into a prepreserved VOC vial containing a stir bar, sodium bisulfate (5 mL) and distilled water.
8. If the sample is collected for high level volatile analysis, the sample will be extruded into a VOC vial containing “Purge and Trap” grade methanol (15 mL).
9. The syringe will be filled with undisturbed soil of the following approximate volumes: 5 grams of soil for low-level analysis (added to the soil of reagent grade water); and/or 15 grams of soil for high level analysis (added to the 15 mL of methanol).

10. Any particles of grains present on the container rim or cap will be removed to ensure an adequate seal of the vial. The VOC vial will be capped quickly and labeled/tagged with sample identifications, date, and time of collection. The container/preservative/sample will then be weighed, and the post-collection weight will also be recorded on the chain of custody. The objective sample weights (5 g for low-level analysis, and 15 g for high level analysis) will be achieved (+/- 10%) with the use of the digital scale. Should insufficient sample volume be added to the preserved container, a stainless-steel spatula will be used to add a small portion of sample until the target weight is achieved (or exceeded within 10%).
11. Collect additional material for the remaining parameters by collecting the sample with the stainless steel spoon and transferring the soil into a stainless steel bowl. Homogenize the sample by mixing the sample within the bowl using the stainless steel spoon prior to filling the remaining sample containers.
12. Record the sample location, identification, and time in the field logbook. Complete the sample log sheet with the following:
    - sample identification number;
    - sample location (sketch of the sample point);
    - sample depth;
    - time and date sample was taken;
    - personnel performing the task;
    - visual description of the sample;
    - brief soil description (color, texture, appearance);
    - weights of preserved VOC containers before and after sample collection; and
    - any other pertinent observations.

After the samples have been collected, the sampling location will be marked with wooden stakes colored with highly visible spray paint and labeled/tagged with the location identification in order to record the sample location.

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at 4°C (±2°C) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. VOC samples collected in water have a 48 hour holding time in which to be received by the analytical laboratory. Refer to the Standard Operating Procedure 500 for sample shipping.

Refer to the FSP for equipment decontamination procedures.

STANDARD OPERATING PROCEDURE NO. 500

PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

Prepared by:_____ Date:_22 September 2016_

Reviewed by:_____Date:_____

Approved by:_____ Date:_____

SOP No. 500

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STANDARD OPERATING PROCEDURE NO. 500
PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to establish packaging and shipping requirements and guidelines for environmental sample shipping. Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis.

This SOP will be implemented in accordance with the following governing documents:

- Drum Removal Work Plan (DRWP), which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the DRWP;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The purpose of appropriate packaging and shipping for environmental samples is to protect the integrity of environmental samples shipped for analysis and to ensure that environmental samples arrive at the environmental laboratory in good condition for analysis.

1.3 Equipment

Equipment needed for packaging and shipping of environmental samples includes:

- coolers with return address of site office written on inside lid;
- heavy-duty plastic overbags, cooler-size;
- plastic zip-top bags, small and large;
- plastic packing tape;
- duct tape;
- bubble wrap;
- ice;
- chain-of-custody seals;
- completed Chain-of-Custody Record;
- completed bill of lading or airbill.

The term "Environmental Sample" refers to any sample that has less than reportable quantities of any hazardous constituents according to Department of Transportation (DOT) 49 CFR - Section 172.

2. PROCEDURES

The following steps must be followed when packing for shipment by air:

1. Select a sturdy cooler in good repair. Secure and tape the drain plug (inside and outside) with duct tape.
2. Be sure the caps on all bottles are tight (will not leak); check to see that labels/tags and Chain-of-Custody Records are completed properly.
3. Double-bag ice in large plastic zip-top bags and properly seal.
4. Place all bottles in separate and appropriately-sized plastic zip-top bags and close the bags. Up to three volatile organic compound (VOC) vials may be packed in one bubblewrap envelope placed inside a zip-top bag; alternatively, nine VOC vials may be packed in a foam cube with vial slots, with the cube packed in a zip-top

bag. Glass bottles should be wrapped in bubble wrap before placing in zip-top bags.

5. Place two to four inches of packing peanuts or vermiculite into the bottom of the cooler. Alternatively, place two layers of large-bubble bubble wrap on the bottom of the cooler.
6. Place a clear, cooler-size overwrap bag in the cooler, place one layer of ice and a temperature blank in the bottom of the bag, and then place the bottles in the bag with sufficient space to allow for the addition of a second layer of ice bags over the sample containers. It is preferable to place glass sample bottles and jars into the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather then horizontally.
7. Place the second layer of ice bags on top of the samples. Close and securely fasten the top of the large overbag with tape (preferably duct tape).
8. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-top bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.
9. Packing tape shall be wrapped around each end of the cooler two times, and completed Chain-of-Custody seals affixed to the top opposite sides of the cooler half on the tape so that the cooler cannot be opened without breaking the seal. Wrap clear tape over custody seals.
10. The shipping containers must be marked with THIS END UP, and arrow labels, which indicate the proper upward position of the container, should be affixed to the cooler. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted to be on the outside of the container used to transport environmental samples and shall not be used.

STANDARD OPERATING PROCEDURE NO. 600

EQUIPMENT DECONTAMINATION

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

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STANDARD OPERATING PROCEDURE NO. 004

EQUIPMENT DECONTAMINATION PROCEDURES

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for decontamination of field equipment used in the investigation of sites with hazardous and potentially radiological waste.

1.1Objective

The objective of equipment decontamination is to remove potential contaminants from a sampling device or item of field equipment prior to and between collection of samples for laboratory analysis and limit personnel exposure to residual contamination that may be present on used field equipment.

1.2 Equipment

The following equipment may be utilized when decontaminating equipment. Site-specific conditions may warrant the use or deletion of items from this list.

- Alconox, liquinox or other non-phosphate concentrated laboratory grade soap;
- Deionized water;
- Pump sprayer;
- 1-pint squeeze bottle filled with pesticide-grade hexane;
- 1-pint squeeze bottle filled with pesticide-grade methanol;
- 1-pint squeeze bottle filled with ten (10) percent nitric acid;
- 1-pint squeeze bottle filled with one (1) percent nitric acid;
- Five large plastic wash basins (24 inches by 30 inches by 6 inches deep);
- Two coarse scrub brushes;
- Small wire brush;
- Aluminum foil;
- Polyethylene sheeting;
- Two large capacity barrels;
- All necessary personal protective equipment (gloves, eyewear, tyveks);
- Extra quantities of above listed liquids;

- 4 inch Schedule 40 PVC pipe 4 feet in length with an end cap for decontaminating groundwater pumps and associated tubing (if needed); and
- High pressure sprayer with water supply.

2.0 PROCEDURES

2.1 General

The following procedures should be used for decontaminating field equipment. Procedures will vary with equipment used and potential contaminants present at the site.

2.2 Procedure for Soil Sampling Equipment

Soil sampling equipment, such as split spoon samplers, shovels, augers, trowels, spoons, and spatulas will be cleaned using the following procedure.

1. All tools being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a tool is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Place five wash basins in an established decontamination area that has a low permeability liner (e.g., polyethylene) and secondary containment. The decontamination area must be of sufficient size to allow placement of the five plastic wash basins in a line, and provide an air drying area for equipment.

3. Fill the first wash basin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of the soap or rinsing the soap residue off the equipment will be difficult.

4. Using a clean coarse scrub brush, wash the sampling equipment in the soap solution in the first basin, removing all dirt. Be sure to wash inside surfaces of equipment as well as the exterior surfaces. Allow excess soap to drain off the equipment when finished.

5. Rinse the equipment with tap water in the second basin, using a coarse scrub brush or pressure sprayer to aid in the rinse, if necessary.

6. If the equipment is being used to sample for metals, rinse the equipment with nitric acid in the third basin. A 10 percent solution is used on stainless steel equipment. A one percent solution is used on all other equipment. If no metals sampling is being performed, this step may be omitted.

7. Spray down the equipment in the third basin, using deionized water.

8. Spray down the equipment in the fourth basin, using pesticide-grade methanol, if sampling for organic compounds is to be performed. If oily, a two-step process using methanol, followed by hexane should be used to remove both water soluble and non-soluble compounds. If no samples for organic compounds are being collected, this step may be omitted.

9. Allow the equipment to completely air dry on clean polyethylene sheeting.

10. Rinse the equipment in the fifth basin, using deionized water.

11. Allow the equipment to completely air dry on clean polyethylene sheeting.

12. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport. Re-use of equipment on the same day without wrapping in foil is acceptable.

13. Allow spent cleaning solutions in the trays to evaporate into the air. If evaporation is not possible, all spent cleaning solutions shall be drummed for disposal along with any other contaminated fluids generated during the field investigation.

14. Record the decontamination procedure in the field logbook or on appropriate field form.

15. If step 8, rinsing with organic solvents, was performed, check the equipment for the presence of residual solvents with a photoionization or flame ionization detector prior to use. If a detection occurs, disassemble the equipment and allow to air dry until no readings are observed, then re-rerinse with deionized water.

16. If a tool that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

17. If the tool cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The tool shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

Note that if temperature or humidity conditions preclude air drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air dry equipment completely prior to reuse should be noted in the field logbook. In this case, additional rinses with deionized water should be used and recorded.

2.3 Procedure for Ground Water Sampling Equipment

Ground water sampling equipment, such as bailers and stainless steel cord, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Place five wash basins in an established decontamination area that has a low permeability liner (e.g., polyethylene) and secondary containment. The decontamination area must be of sufficient size to allow placement of the five plastic wash basins in a line, and provide an air drying area for equipment.

3. Fill the first wash basin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of soap or rinsing the soap residue off the equipment will be difficult.

4. Wash the sampling equipment in the soap solution in the first basin, removing all residues. Be sure to wash inside surfaces of equipment as well as exterior surfaces. Allow excess soap to drain off the equipment when finished.

5. Rinse the equipment with tap water in the second basin.

6. If the equipment is being used to sample for metals, rinse the equipment with nitric acid in the third basin. A 10 percent solution is used on stainless steel equipment. A one percent solution is used on all other equipment. If no metals sampling is being performed, this step may be omitted.

7. Spray down the equipment in the third basin, using deionized water.

8. Spray down the equipment in the fourth basin, using pesticide-grade methanol, if sampling for organic compounds is to be performed. If oily, a two-step process using methanol, followed by hexane should be used to remove both water soluble and non-soluble compounds. If no organic compounds sampling is being performed, this step may be omitted.

9. Allow the equipment to completely air dry on clean polyethylene sheeting.

10. Rinse the equipment in the fifth basin, using deionized water.

11. Allow the equipment to completely air dry on clean polyethylene sheeting.

12. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport. Re-use of equipment on the same day without wrapping in foil is acceptable.

13. Allow spent cleaning solutions in the trays to evaporate into the air. If evaporation is not possible, all spent cleaning solutions shall be drummed for disposal along with any other contaminated fluids generated during the field investigation.

14. Record the decontamination procedure in the field logbook or appropriate field form.

15. If step 8, rinsing with organic solvents, was performed, check the equipment for the presence of residual solvents with a photoionization or flame ionization detector prior to use. If a detection occurs, disassemble the equipment and allow to air dry until no readings are observed. Re-rinse with deionized water.

16. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

17. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

Note that if temperature or humidity conditions preclude air drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air dry equipment completely prior to reuse should be noted in the field log. In this case, additional rinses with deionized water should be used and recorded.

2.4 Procedure for Oversized Equipment

Oversized equipment, such as submersible pumps, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Fill two clean barrels with tap water.

3. Add sufficient concentrated soap to one barrel to form a thin layer of soap suds.

4. Immerse the pump in the soap containing barrel and start pump. Circulate the soap solution through the pump and feed discharge into a waste disposal drum.

5. Immerse the pump in the barrel filled with clean tap water and start pump. Circulate the water through the pump and feed discharge into a waste disposal drum. Run the pump until no soap residue is visible in the discharge.

6. Deionized water should then be run through the pump and used to rinse all submersible parts and hoses.

7. Record the decontamination procedure in the field logbook or appropriate field form.

8. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

9. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

2.5 Procedure for Measuring Equipment

Measuring equipment, such as pressure transducers or water level indicators, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Fill two clean basins with tap water.

3. Add sufficient concentrated soap to one basin to form a thin layer of soap suds.

4. Immerse the device in the soap containing basin and gently agitate. Scrub device if it is soiled. Do not submerse any electrical connectors or take up reels, only that portion of the device in contact with potentially contaminated water.

5. Immerse the device in the basin containing the rinse water and gently agitate. Do not submerse any electrical connectors or take up reels, only that portion of the device in contact with contaminated water.

6. Spray rinse equipment with deionized water.

7. Allow the equipment to air dry.

8. Record the decontamination procedure in the field logbook or appropriate field form.

9. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

10. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

ATTACHMENT 1

CONTAMINATED PERSONNEL OR PERSONAL EFFECTS REPORT

DATE OF INCIDENT:	TIME OF INCIDENT:
NAME:	BADGE NO.
LOCATION OF INCIDENT (SPECIFIC AREA)	
DESCRIPTION	DESCRIBE IN DETAIL ANATOMICAL LOCATION, CONTAMINANT, TYPE OF INJURY, OR CONTAMINATED ARTICLE

CONTAMINATED ARTICLE OR AREA	DECONTAMINATION AGENT USED	INSTRUMENT	SURVEY RESULTS		FINAL DISPOSITION OF ARTICLES
			BEFORE	AFTER	

WOUND COUNT /5 MIN	BKGD COUNT /5 MIN	SOURCE COUNT /5 MIN

	PERTINENT SAFETY MEASURES IN EFFECT ☐ YES ☐ NO	IF NO, EXPLAIN
SAFETY MEASURES		
REMARKS		

EMPLOYEE SIGNATURE	HEALTH PHYSICS SIGNATURE

ATTACHMENT A

QUALITY MANAGEMENT PLANS

Geosyntec Consultants, Inc.

ACTenviro

CONTRACTOR & SUBCONTRACTOR QUALIFICATIONS

Geosyntec Consultants, Inc.

ACTenviro

PSC

ALS Environmental

Scott Contracting, Inc.

TestAmerica Laboratories, Inc.

DS Environmental

ATTACHEMENT A-1

QUALITY MANAGEMENT PLANS

Prepared for

United States EPA, Region 8

GEOSYNTEC QUALITY MANAGEMENT PLAN

Revision: 01

Prepared by

Geosyntec consultants

engineers | scientists | innovators

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DE0302

December 5, 2017

QUALITY MANAGEMENT PLAN
Final Revision

October 2016

Michael D'Alessandro / October 4, 2016

Geosyntec Corporate Quality Assurance Manager, Vice President

Printed Name / Date

Julia Klens Caprio / October 4, 2016

Geosyntec Project Quality Assurance Manager

Printed Name / Date

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Figure 1 – Quality Assurance – Lines of Authority

APPENDICES

Appendix A – Review Forms
Senior
Peer

1. INTRODUCTION

1.1 Purpose of the Quality Management Plan

This Quality Management Plan (QMP) implements the quality management requirements of Section 11 of Geosyntec's Risk Management Program (RMP). The goal of this QMP is to promote quality in all of our services and work products thereby enhancing the performance, reliability, and safety of our solutions and recommendations and the satisfaction of our clients.

This QMP is an "umbrella" quality assurance (QA) document that describes the quality-related processes and procedures that are to be implemented by Geosyntec. This document applies to all subsidiaries and practices of Geosyntec Consultants, Inc. unless the use of a QMP prepared specifically for/by a subsidiary or practice group has been endorsed by the Geosyntec Corporate Quality Assurance Manager (CQAM) and approved by Geosyntec's Risk Management Committee (RMC).

A portion of Geosyntec's work today involves projects for industry and government clients actively regulated by the U.S. Environmental Protection Agency (EPA), state environmental agencies, federal and state water agencies, the Federal Energy Regulatory Commission (FERC), the U.S. Army Corps of Engineers (COE), the U.S. Nuclear Regulatory Commission (NRC), and others. Additional QA procedures, beyond those discussed in this plan may apply to such work because of the specific QA requirements of these agencies. Where additional regulatory or contractual QA procedures apply, this plan calls for Geosyntec to comply with such procedures.

Many of Geosyntec's projects, however, do not require EPA, FERC, or NRC QA procedures. Rather they include a wide variety of projects for a broad spectrum of clients. Achieving quality in these projects includes meeting informed client objectives in a manner consistent with applicable standards of professional care and budgetary constraints. In the past, Geosyntec has relied on the professional excellence of its principals and project managers to achieve project quality. That will continue to be the case in the future. However, given the firm's growth, both in volume and complexity of projects, Geosyntec is implementing a more formalized and systematic structure to help its principals and project managers achieve quality objectives. This QMP describes Geosyntec's quality assurance program structure and implementation plan.

1.2 Reference Documents

The following documents were reviewed and considered in developing this QMP.

- American Society of Quality/American National Standards Institute (ASQ-ANSI) E4:2014, "Quality management systems for environmental information and technology programs – Requirements with guidance for use," ASQ/ANSI, February 2014;
- American National Standards Institute/American Society of Quality Control (ANSI/ASQC) E4-1994, Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," ANSI/ASQC, 1994;

- Requirements for Quality Management Plans (QA/R-2)," (EPA/240/B-01/002), March 2001, re-issued May 2006;
- EPA Requirements for Quality Assurance Project Plans (QA/R-5), (EPA/240/B-01/003), March 2001;
- Guidance for Quality Assurance Project Plans (QA/G5), (EPA/240/R-02/009. December 2002;
- Guidance on Systematic Planning Using the Data Quality Objectives Process (QA/G-4), (EPA/240/B-06/001), February 2006;
- Guidance for Preparation of Standard Operating Procedures (QA/G-6), (EPA/600/B-07/001), April 2007;
- Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), OSWER Directive 9272.01-17;
- USACE ER 1110-1-263 Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities, 30 April 1998; and
- Geosyntec Risk Management Program, 2016.

1.3 Definition of Quality Assurance and Quality Control

The definitions for quality assurance and quality control used in this QMP are taken directly from the ANSI/ASQC (1994) document referenced in Section 1.2.

"Quality Assurance (QA) – an integrated system of management activities involving planning, implementation, assessment, reporting, and improvement to ensure that a process, item, or service is of the type and quality needed. QA is typically applied by managers or technical personnel assigned to a specific oversight role. Example QA activities include technical and management assessments of field and analytical operations."

"Quality Control (QC) – an overall system of technical activities that measures the performance of a process, item, or service against defined standards to verify that the performance meets the stated requirements. QC is typically applied by technical personnel. Example QC activities include the use of control samples during sample collection, handling, and analysis, and activities such as data review."

1.4 Scope of Activities Covered by the QMP

The QMS structure and guidance described in this QMP have been developed to cover the range of work tasks involved in Geosyntec projects, which typically include some or all of the following: project management; project planning and work plan preparation; health and safety planning and management; information/data collection; data management, interpretation, and use; analytical and numerical modeling and analysis; study design and implementation; engineering design; preparation of plans and specifications; construction oversight; systems start-up and operations; and work product preparation and reporting. Geosyntec's technical personnel

participate in "Action Groups" and "User Groups" (herein simply referred to as Action Groups) for many of the firm's areas of practice. One important function of the Action Groups and User Groups is to enhance project quality by promoting firm-wide cooperation among practitioners. This QMP has been developed to cover all of Geosyntec's practices.

1.5 Revisions to the QMP

This QMP is reviewed and updated on a periodic basis by the CQAM. The periodic review process is designed to maintain quality management practices that are consistent and compatible with the dynamic characteristics of a growing company, project needs, and regulatory requirements. Changes to the QMP are maintained in a controlled document format. Any changes are reviewed and approved by the RMC.

2. MANAGEMENT AND ORGANIZATION

2.1 Geosyntec's Mission Statement and Values

The mission of Geosyntec is to be the leading consulting and engineering (C&E) family of companies that is the consultant and engineer of choice for first class clients and the employer of choice for exceptionally talented and motivated engineers, scientists, and related professionals. Geosyntec's values are centered on honesty and integrity, employee health and safety, collegiality and cooperation, technology and practice leadership, client service and project management excellence, lifelong professional development, a generous spirit, sharing of opportunities, workplace diversity, and work-life balance.

2.2 Geosyntec's Approach to Quality Management

Geosyntec's QMS utilizes a tiered approach to quality management. With this tiered approach, the levels of managerial control and resource allocation for QC/QA purposes are based on: the complexity and size of the project; the degree of accuracy and/or certainty needed in the project data, analyses, designs, and results; and, the applicable standard of professional care for the type of work being performed. Geosyntec is committed to utilizing quality management principles and practices for activities involving: project management; project planning and work plan preparation; health and safety planning and management; information/data collection; data management, interpretation, and use; analytical and numerical modeling and analysis; study design and implementation; engineering design; preparation of plans and specifications; construction oversight; systems start-up and operations; and work product preparation and reporting. The intent of Geosyntec's QMS is to implement a systematic approach to QC/QA in a manner that is technically sound, legally defensible, and produces results of known and documented quality.

2.3 Authority and Responsibilities

2.3.1 Overview

Geosyntec's tiered QMS provides the means for managers and staff to implement the firm's quality program and thereby achieve the program's quality goals. At each management tier, personnel with quality management roles are identified and their related responsibilities are defined. The management tiers include company-wide responsibilities, operating group responsibilities, Action Group responsibilities, and project-specific responsibilities. This subsection describes the quality management roles and responsibilities of Geosyntec personnel. Figure 1 shows the organizational structure of the key personnel involved in Geosyntec's QMS.

2.3.2 President/CEO and Executive Committee

Geosyntec's President/Chief Executive Officer (CEO) has executive authority and responsibility for the QMS for Geosyntec and subsidiaries. The President/CEO is assisted in this responsibility by members of the Executive Committee that have operating responsibilities for Geosyntec and its subsidiaries. These individuals are responsible for allocating adequate resources, including both budgeted funds and personnel, to implement Geosyntec's quality program in support of the

company's mission. The President/CEO and Executive Committee periodically review the allocation of company resources to ensure that adequate staff, equipment, and materials are dedicated to the company's quality program. The President/CEO and Executive Committee are also responsible for developing the qualifications requirements and position description for the CQAM, for filling that position, for evaluating the performance of the CQAM, and for reviewing the results of QMS system management assessments.

2.3.3 Risk Management Committee (RMC)

Because of the importance of risk management in protecting the company, the Board of Directors (Board) established an RMC. Recognizing the close connection between risk management and operational decisions, the Board concluded that the RMC should be composed of the following officers: Chairman of the Board, CEO, Chief Financial Officer (CFO), other members of the Executive Committee, the General Counsel, and select individuals appointed by the Chairman. The RMC has the following responsibility with regard to Geosyntec's QMS:

- reviewing and approving this QMP, including any revisions (an authority which the RMC may delegate to a subgroup of the committee);
- reviewing and approving any subsidiary-specific or practice-specific QMP;
- reviewing and approving the Guidance for Systematic Planning of Project Work Flow (Work Flow Guidance), including any revisions (an authority which the RMC may delegate to a subgroup of the committee);
- providing input to the President/CEO and Executive Committee on the qualifications requirements and position description for the CQAM;
- as requested by the President/CEO, reviewing and assessing the performance of the CQAM; and
- assisting the CQAM as may be requested to update documents, perform management assessments, evaluate deficiencies, develop corrective actions, and contribute to training.

2.3.4 Corporate Quality Assurance Manager (CQAM)

The CQAM is responsible for overall development of Geosyntec's QMS and implementation of the QMP, including:

- leading development of, and then revisions to, this QMP;
- presenting QMP revisions to the RMC for approval;
- working with Geosyntec's subsidiaries in assessing whether this QMP is adequate for their operations, or instead, if a subsidiary-specific QMP is needed; if the latter, the CQAM will assist the subsidiary in developing a subsidiary-specific QMP and will present the specific QMP along with his/her assessment and endorsement to the RMC for their review and approval;

- working with Geosyntec's Action Groups in assessing whether this QMP is adequate for their practice;
- assisting the team of Action Group Quality Assurance Managers (AGQAMs) and subsidiary personnel in the development of practice-specific and subsidiary-specific QMS materials and training;
- developing and implementing QMS training for Geosyntec personnel and for assuring that subsidiaries and practices with their own QMPs are conducting appropriate training;
- assessing performance of the company and its subsidiaries in implementing the applicable QMPs, developing recommendations to improve performance, guiding implementation of those recommendations, and reporting to the RMC on the results of the assessments; and
- developing and implementing a system for management assessments of specific projects, identifying deficiencies, proposing corrective actions, and reporting to the RMC on the results of the assessments.

2.3.5 Action Group Quality Assurance Manager (AGQAM)

A Quality Assurance Manager (QAM) is assigned by each Action Group to guide the development and implementation of Geosyntec's QMS for the particular area of technical practice. The responsibilities of each AGQAM are:

- providing input to the development and revision of the QMP;
- guiding and scheduling the development, maintenance, assessment, and revision of the QMP, as appropriate, for the applicable Action Group;
- maintaining a library of practice-specific QC/QA documentation that is made available to technical staff;
- providing input to the CQAM and senior management in assessing the effectiveness of practice-specific training initiatives;
- assisting Project Directors (PDs) and Project Managers (PMs), as requested, in establishing project-specific quality objectives (PQOs) and in preparing project QA requirements and Quality Assurance Project Plans (QAPPs) when such are used;
- as requested, serving as a resource to PMs, and Project Quality Assurance Managers (PQAMs) when used, regarding identified project-specific QMS deficiencies and corrective actions; and
- as may be requested by the CQAM, participating in Action Group specific QMS reviews to: (i) review the results of assessments, discrepancy resolution, and corrective actions; (ii) identify and implement opportunities for improvement; (iii) lead the Action Group in updating its related QA materials.

2.3.6 Project Director (PD)

The PD (or designee as allowed by the RMP; hereafter in this report referred to simply as PD) is responsible for project-specific implementation of, and compliance with, the QMP, including:

- reviewing the proposal for inclusion of appropriate QC/QA protocols in the proposed scope, budget, and schedule;
- assessing whether a QAPP should be prepared for a project;
- assessing whether a dedicated PQAM is needed for the project, in lieu of the PM who will lead the QA effort for most projects;
- providing guidance to project personnel throughout the project, with the goal of achieving conformance with this QMP and other applicable QA material;
- confirming that PMs and project staff are appropriately trained for their project roles;
- confirming that project activities, including all necessary review processes, are conducted in accordance with the RMP and other company policies;
- resolving project-specific issues regarding implementation of the QMS; and
- leading project-specific management assessments as requested by the CQAM to confirm that the foregoing objectives are being achieved.

The PD has overall supervisory responsibility for the project, including achieving scope, schedule, budget, and health and safety requirements.

2.3.7 Project Manager (PM)

It is the responsibility of the PM to communicate the applicable QMS requirements to the project team and to see to it that these requirements are built into project work plans and/or work processes. The PM should use a project initiation meeting to communicate the quality requirements of the project. The PM should lead this initial discussion on project quality requirements.

With regard to Geosyntec's QMS, the PM is responsible for:

- identifying and accounting for the anticipated project quality management requirements, as appropriate, at the time of proposal preparation;
- reviewing the project contract to understand the terms and conditions and to assess conformance of the contract with the RMP requirements;
- utilizing the Work Flow Guidance and RMP to plan the project and develop project work plans (as may be needed) and then communicating this information to project staff;
- for projects that require or need such, identifying project quality objectives (PQOs), and data quality objectives (DQOs), and developing a QAPP;
- identifying in the project work plan, portions of this QMP, regulations, codes, or other guidance applicable to the project; identifying resource needs to achieve project-specific quality goals;

- confirming that project personnel have the appropriate training and experience to both execute their project assignments and implement the QMS requirements that attach to the assignments; and
- identifying any project-related QMS non-compliances and implementing appropriate corrective actions.

2.3.8 Project Quality Assurance Manager (PQAM)

On most Geosyntec projects the PM has responsibility for QMS implementation. For certain projects, however, including those that require such by regulation, contract, or as may be deemed appropriate by the PD, the PD will name a PQAM that is independent of the PM and who reports directly to the PD.

A dedicated PQAM should not be directly involved in performing project work tasks or preparing project work products. If a PQAM does perform a task or prepare a work product, the QA of that task or work product should be performed by another individual, typically the PM. The PD may assign some or all of the QA responsibilities listed in Section 2 to the PQAM. The PQAM may also be responsible for:

- providing assistance to project personnel on implementation of the QMP for the project;
- preparing QMS planning documents for the project, which, depending on the project size and complexity, may include but are not limited to the QAPP, Sampling and Analysis Plan (SAP), Field Sampling Plan (FSP), and other written plans; when these plans are prepared by the PQAM, they should be reviewed by the PM;
- identifying training needs for specific project work;
- conducting task-specific assessments, documenting findings, evaluating proposed corrective actions if deficiencies are identified, and assessing the effectiveness of the corrective actions; and
- communicating to the relevant AGQAM deficiencies and corrective actions that might be of interest to the Action Group.

2.3.9 Project Staff

Project staff are responsible for:

- reviewing and understanding the requirements of this QMP and the RMP, as appropriate for conducting their project assignments;
- reviewing and understanding the project work flow guidelines contained in the Work Flow Guidance, as appropriate for conducting their project assignments;
- reviewing and understanding the project work plan, scoping documents, regulations, codes, and guidelines, as appropriate for conducting their project assignments;

- attending the project initiation meeting to be informed by the PM or PQAM of the quality management requirements of the project;
- promptly reporting to the PM any project-specific data quality or other problems identified during the conduct of his/her project work;
- conducting work in accordance with approved project-specific QMS documents, as applicable, and discussing potential deviations from these documents with the PM; and
- coordinating and facilitating peer reviews of data, calculations, analyses, models, spreadsheets, drawings, tables, memoranda, letters, and reports produced during the conduct of his/her work.

2.4 Issue Resolution

Issues that arise regarding the application of QMS procedures to a specific project should be resolved by the PM and/or PQAM, as applicable, with input from resources such as the AGQAM. Should the issue remain unresolved, the issue should be elevated to the attention of the PD. Resources available to the PD include the CQAM and, if needed, the RMC.

3. COMPONENTS OF THE GEOSYNTEC QMS

3.1 Overview

The Geosyntec QMS comprises a number of functional components, in addition to this QMP, including:

- Guidance for Systematic Planning of Project Work Flow (Work Flow Guidance);
- Quality Assurance Project Plans (QAPPs);
- standard operating guidelines (SOGs) and procedures (SOPs);
- management assessments;
- systematic planning processes;
- data quality objectives (DQOs);
- peer, senior, and document reviews; and
- data quality assessments.

A discussion of each of these functional components of the Geosyntec QMS is provided in the remainder of this section.

3.2 Guidance for Systematic Planning of Project Work Flow

Geosyntec is a business that performs projects for clients to help those clients with their new ventures or existing problems involving the natural and built environments. These projects involve the application of engineering, science, risk management, project management, construction management, and related disciplines to the project effort. Most projects have common management and work flow characteristics. The Work Flow Guidance provides a "roadmap" of this typical project workflow and a list of relevant considerations at each stage of the project. The Work Flow Guidance provides tools and templates to assist staff in planning and executing projects. Geosyntec management believes that recognition of this work flow process by Geosyntec staff, and review of the work flow elements in the context of each project, are helpful in achieving a quality project.

Geosyntec's Work Flow Guidance is presented in Appendix A of this QMP. The Work Flow Guidance is reviewed by the CQAM on a periodic basis (typically in parallel with the QMP review). Revisions are approved by the RMC.

3.3 Quality Assurance Project Plans (QAPPs)

Some Geosyntec projects are required by regulation or contract to have a QAPP. In addition, certain other Geosyntec projects may be of such a scope and complexity that the PD deems it appropriate to prepare QAPP in order to facilitate systematic project planning. QAPPs are project-specific documents that describe the QC/QA and related technical activities that are to be carried out to facilitate project quality objectives.

Not all projects require the preparation of a QAPP. Simpler documentation will often be sufficient. For example, for projects that do not require a QAPP, the elements of QC/QA can be incorporated into the work plan, either within the main body of the text or, if sufficient, as a memorandum or attached list. The PD and PM determine whether a QAPP should be prepared or simpler documentation will suffice.

When a project uses a QAPP, it should be commensurate with the size, complexity, and regulatory requirements of the project. Where applicable, the QAPP identifies SOGs and/or SOPs that should be followed. For example, for projects needing to meet EPA, FERC, or NRC QC/QA processes not specifically addressed by this QMP plan, these processes should be incorporated into the QAPP.

3.4 Standard Operating Guidelines (SOGs) and Procedures (SOPs)

SOGs may be prepared to provide practice-specific guidance on methods of field investigation, data collection, analysis, calculation, modeling, design, work product preparation, or other activity. SOGs are intended to help the user achieve quality objectives and the applicable standard of care in a particular work activity. They are typically developed for activities that are conducted on a regular basis. For example, SOGs may be developed for routine activities associated with obtaining samples, field measurements/data collection, numerical modeling, engineering calculations, design processes, and preparation of plans and specifications. SOGs are typically contained in the QA materials of practice-specific Action Groups.

An SOP is a procedure approved by the PM to be used by project staff for the conduct of a specific project activity. Depending on the size and complexity of the project, SOPs may be included as part of, or referenced in, the project-specific QAPP, work plan, or task descriptions. SOPs may be derived from SOGs or developed specifically for a project.

Section 9 of this QMP addresses the development, review, and approval of SOGs and SOPs.

3.5 Management Assessments

Management assessments are reviews and evaluations conducted by Geosyntec of the effectiveness of the QMS and its implementation on individual projects.

The objectives of management assessments of the QMS are to:

- evaluate the implementation of Geosyntec's QMS and whether the expected results are being obtained;
- evaluate whether the components of the QMS, including the QMP, Work Flow Guidance, SOGs, SOPs, and other quality-related documents are being used as intended by the QMS;
- evaluate whether a plan exists and is being implemented for management assessments of individual projects;
- identify omissions or limitations in the components of the QMS and evaluate and implement improvements, as appropriate;

- review any complaints received, identify the cause(s), and recommend corrective action(s), as appropriate; and
- review the findings of internal/external audits and identify areas of recurring problems or potential improvements.

Management assessments of Geosyntec's QMS are to be conducted periodically by the CQAM under the direction of President/CEO and Executive Committee. These assessments are to be performed by personnel with appropriate training and experience to competently make the assessment. These personnel should not have been directly involved in the preparation of the activities being assessed.

Management assessments of individual projects may be performed on active projects or on projects that have been completed. The PD or CQAM may initiate a management assessment of a specific project. It is the responsibility of the CQAM, in consultation with the RMC, to develop and implement a periodic management assessment strategy which evaluates the effectiveness of the QMS at the project level. Management assessments of projects may be performed by the PD, CQAM, or a qualified individual independent of the project team. The PM and other project personnel should not lead the project management assessment.

Additional discussion of management assessments is contained in Section 11 of this document.

3.6 Systematic Planning

Project planning relative to quality requires a systematic process that is coordinated by the PM. Geosyntec has established the Work Flow Guidance to help in this systematic planning process and in systematic project execution that follows.

Once the project objectives are identified, a scope of work (including project deliverables), budget, schedule, and health and safety requirements are developed with project team members who are involved in the planning process. QC/QA requirements should be included in the project planning process. Financial and human resources necessary for implementation of the quality management activities should be addressed in the project budget and staffing plan. The need for a project-specific QAPP is assessed during the planning process. If a QAPP is not required, the QC/QA requirements should be documented in the project work plan or project memoranda.

3.7 Data Quality Objectives (DQOs)

PMs and project staff should consider DQOs for the data that will be collected or generated on a project. The purpose of the DQO process is to achieve a level of data quality appropriate to the project, including client and contractual requirements, any regulatory requirements, and the applicable professional standard of care. The DQO process can vary significantly depending on the nature of the project, the technical disciplines involved, and the size and complexity of the project. The DQO process for Geosyntec projects is sometimes implemented informally. In other cases, the DQO process it might involve compliance with prescriptive standards and guidelines such as those issued by the American Society of Testing and Materials (ASTM). In

yet other cases, DQOs will be established in detail on a project-specific basis and presented in the QAPP.

3.8 Peer and Senior Reviews

Geosyntec's QMP contains two specific types of reviewing and checking activities that are associated with every project: peer reviews and senior reviews. Each is described below:

The peer review process involves the review and checking of data, calculations, analyses, models, studies, and other project activities. Peer reviews are intended to identify and correct errors or mistakes in draft work products and to evaluate the work inputs, methodologies, and results. Peer reviews are conducted by Geosyntec personnel selected by the PM based on qualifications, relevant experience, and/or training to perform the review. Reviewers may be part of the project team, but are usually not involved in the work being reviewed. Reviews may also be conducted by non-project personnel. Peer review is essentially a QC function that is integral to the project. Peer reviews are documented, and there is a written record that the review was completed and the review comments were resolved. Each Action Group develops peer review processes appropriate to their practices. The InfoPath forms include the material to be reviewed, the name of the person(s) who prepared the material to be reviewed, confirmation by the reviewer(s) that review comments were addressed and resolved. This documentation from the completed peer review is retained on the QMS SharePoint site and may also be retained in the project file.

Senior review is the term that applies to the ongoing review of the entire project by the PD to confirm that the project scope, schedule, budget, and health and safety requirements are achieved, that the project-related guidelines of the RMP and QMP are satisfied, and that the project has been performed in accordance with the applicable standard of professional care. Another important function of senior review is to see that the project file is complete and in accordance with Chapter 13 of the RMP and that all necessary peer review documentation is in the project file. See the QMS Website for Procedures for Documenting Senior Reviews. The InfoPath forms include the project and report or material reviewed, the name of the project manager, the name of the senior reviewer (if a designee), and the name of the PD approving the senior review. This documentation from the completed senior review is retained on the QMS SharePoint site and may also be retained in the project file.

Document review is that subset of the senior review process described in Chapter 11 of the RMP. The RMP policy requires that any document (except contracts, which must be reviewed consistent with the contract review procedures set forth in the RMP) that offers or provides any of the following information, regardless of whether it is generated under a practice-specific quality management guideline or not, must be reviewed by a PD who must have the appropriate practice background: (i) offers a commitment to perform services (i.e., proposal); (ii) provides results of engineering evaluations; and (iii) provides consulting or engineering recommendations, opinions, or conclusions or otherwise commits the company.

The PM is responsible for retaining records in the QMS SharePoint file or in the project file showing that peer and senior reviews were completed. In accordance with Geosyntec's document retention policy (Chapter 13 of the RMP), draft documents that contain internal peer

review comments, are not to be retained after the comments have been appropriately addressed, unless the project contract requires otherwise. Review comments from third-party reviewers, such as regulators, are retained in the project file.

Reviews are performed to assure that the scopes of work and contractual requirements have been properly addressed, the conclusions are appropriate, the tone and format of the document is appropriate, that technical review documentation is complete, as appropriate, and that any limitations associated with the work are identified.

Additional discussion of peer and senior reviews is presented in Section 10 of this document.

3.9 Data Quality Assessments

PMs and project staff should consider data quality assessments for the data that will be collected or generated on a project. The purpose of the data quality assessment process is to achieve a level of data quality appropriate to the project, including client and contractual requirements, any regulatory requirements, and the applicable standard of professional care. The data quality assessment process itself, can vary significantly depending on the nature of the project, the technical disciplines involved, and the size and complexity of the project. The data quality assessment process is sometimes implemented informally. In other cases, it might involve compliance with published standards and guidelines such as those issued by the American Society of Testing and Materials (ASTM). In yet other cases, data quality assessments will be established in detail on a project-specific basis and presented in the QAPP.

4. PERSONNEL QUALIFICATIONS AND TRAINING

4.1 Personnel Qualifications

Geosyntec policy is that company personnel need to meet or exceed the educational and professional experience qualifications for each individual's position and work responsibilities. These requirements are presented on the Geosyntec SharePoint intranet site in written position descriptions that include:

- general statement of duties;
- reporting relationship;
- duties and responsibilities;
- qualifications; and
- career development.

Geosyntec's Human Resources Department is responsible for maintaining these position descriptions.

Geosyntec personnel who engage in field activities may be required by Occupational Safety and Health Administration (OSHA) and Geosyntec policy to have Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour training together with an annual 8 hour HAZWOPER refresher and medical monitoring. Training may be conducted by internal or external staff. Specific safety training requirements are provided in the Geosyntec Health and Safety policy, which may be found on the Geosyntec SharePoint intranet site.

4.2 Commitment to Training

Geosyntec trains its staff to perform projects consistent with the project scope of work and contractual requirements, applicable rules, regulations, codes, and guidelines, the applicable standard of professional care, and safe work practices. This type of training is conducted at the company-wide, regional, practice-specific, and project-specific levels. Project-specific training requirements for personnel are typically included in project documents such as a QAPP, work plan, or scope of work.

Geosyntec's employee policies, as described in the Employee Handbook, encourage employees to attend training seminars and classes that are directly related to their job functions and career development. These may be offered within Geosyntec; at colleges and universities; by local, state, and federal agencies; through computer software and on-line programs; and by professional societies and conference sponsors. Geosyntec training resources include Action Group conferences, internal and external webinars, and on-site sessions. Registered (licensed) professionals (e.g., engineers, geologists) at Geosyntec proactively participate in continuing education activities (Professional Development Hours [PDHs] or Continuing Education Units [CEUs]) for compliance with their professional license requirements. Geosyntec uses an intranet website to store educational and training information pertaining to personnel, technical Action Groups, health and safety, management operations, and Geosyntec procedures.

The practice-specific Action Groups are a major force in promoting, coordinating, and disseminating practice development and training activities for personnel in the firm. The Action Groups provide technical education and training, publicize and present technical topics, develop new technologies, and act as an interoffice communications mechanism for the development of work practice and QC/QA guidelines. The activities of the Action Groups are key elements in helping Geosyntec maintain its position as technology leaders and providers of innovative solutions. The organizational role of the Action Groups in Geosyntec's QMS is illustrated in Figure 1.

In addition to the commitment to technical training described above, Geosyntec provides training to its staff in a number of management-related topic areas. These specifically include: (i) project management; (ii) risk management; (iii) health and safety; and (iv) company and project finance and accounting.

4.3 Training Roles and Responsibilities

Geosyntec project staff are provided with the appropriate level of QC/QA training commensurate with their duties. It is a responsibility of senior management to establish QC/QA training needs for personnel involved in: project management; project planning and work plan development; information/data collection; data management, interpretation, and use; analytical and numerical modeling and analysis; study design and implementation; engineering design; preparation of plans and specifications; construction oversight; systems start-up and operations; and work product preparation and reporting. Each AGQAM is responsible for maintaining a library of pertinent QC/QA documentation to assist in training technical staff, providing input to the CQAM and senior management in assessing the effectiveness of practice-specific training, and evaluating and communicating the need for retraining based on the results of management assessments.

The PD is ultimately responsible for the quality of a project. Therefore, it is the PD's responsibility to confirm that the PM has received training sufficient to understand the importance of QC/QA, his/her responsibilities with regard to QC/QA during data collection and other project activities, and applicable requirements and guidelines of the Geosyntec QMP and RMP. Retraining based on changing requirements occurs as needed.

The PM is responsible for confirming that project personnel have received training sufficient to competently perform their project assignments, including implementing applicable QC/QA requirements, and conforming with applicable regulations, codes, and standard of care.

4.4 Documentation of Staff Training and Education

Job opening announcements at Geosyntec are based on the requirements of the position in terms of education and experience. A permanent record of the successful applicant's resume, with education and work experience, is maintained by Geosyntec's Human Resources Department. New staff members are also required to provide written acknowledgements that appropriate policy (e.g., QMP and RMP) and safety manuals have been received and that the employee understands the provisions contained in the documentation. Existing employees are to provide

the same documented acknowledgments for new or revised policies. This documentation is also maintained by the Human Resources Department.

As part of the annual personnel performance evaluation process, Geosyntec employees update their resumes in the areas of education, training, certifications and licenses, work experience, and technical publications. Senior management encourages and supports the ongoing professional development of staff through in-house conferences (e.g., through the Action Group), external conferences, and other forums. With input from the AGQAMs, senior management assesses the effectiveness of the training in the annual evaluation process.

Individual employees maintain their own training records on an updated resume. They may submit their records at any time to Human Resources for maintenance in their personnel files. Environmental Health & Safety Coordinators are responsible for maintain personnel health and safety training records.

5. PROCUREMENT OF GOODS AND SERVICES

5.1 Procurement Source Evaluation and Selection

The PM has primary responsibility for procuring services and products for a project that are of sufficient quality to meet the project objectives, contractual requirements, and applicable standard of care. Purchase requests should identify the performance, quality, and safety requirements of the service or product to be subcontracted or supplied. The PM should make sure that these requirements are communicated to the subcontractor or supplier during the procurement process.

The PM is responsible for evaluating proposals or bids from the subcontractor or supplier against the procurement criteria. Moreover, the PM should, as appropriate, take into account the subcontractors' or suppliers' quality program, and past experience. The PM evaluates responses to bid solicitations to assess technical, quality, and safety criteria. The PM is responsible for engaging the Geosyntec contract management team to review contractual agreements with subcontractors and suppliers as may be needed.

Geosyntec PMs and contracting personnel maintain lists of pre-approved subcontractors and suppliers. Quality defects that affect the performance of services and products obtained from these pre-qualified entities should be reported by the PM to the PD and contracting personnel so that corrective actions can be discussed with the subcontractor or supplier.

Subcontractors retained to provide services must provide evidence of insurance, bonding, licenses and certifications, safety performance, and project-required training, as appropriate to the project requirements. Providers of subcontracted laboratory services must provide adequate documentation to show compliance with accreditation requirements, including the availability of QA Manuals and SOPs, where applicable. When applicable, the PM is responsible for providing project-specific quality requirements (e.g., PQOs, DQOs, QAPP) to subcontractors and suppliers. The PM is also responsible for confirming that subcontractors and suppliers are meeting those requirements during performance of the project.

5.2 Document Retention for Subcontracted Services and Products

Procured services and products will often be accompanied by certifications, QC documentation, warranty information, and operation information. The PM should maintain this information in the project file. This information may include Material Safety Data Sheets that accompany chemical purchases. Providers of subcontracted laboratory services should provide adequate QC information to meet the project DQOs and to enable assessment of the bias and precision (uncertainty) of the reported results.

6. DOCUMENTS AND RECORDS

6.1 Document Retention Policy

Maintenance and retention of documents and records (both printed and electronic) associated with a specific project is the responsibility of the PM and the staff conducting the work. Geosyntec's RMP provides guidelines for maintaining and retaining project-related files, including such items as proposals, contracts, correspondence, data, and project deliverables. Project-specific contract requirements may also exist for retaining, controlling, filing, storing, protecting, and accessing data, documents, and records. Records provide objective evidence of an item or process, and include lab reports, field notes, data recording media, photographs, emails, engineering calculations, modeling results, drawings, and specifications.

6.2 Quality-Related Project Documentation

The PM or PQAM, as applicable, is responsible for identifying the specific quality documentation that may be required for a given project. This documentation may include:

- project-specific work plans and QAPPs;
- QMS-related project memoranda, e-mails, or other correspondence;
- SOGs and SOPs;
- subcontractor and supplier QC/QA manuals, plans, specifications, and QC/QA test results; and
- the project contract, including attachments and addenda.

For environmental work, such as data collection, interpretation, and use, QC/QA records (written and electronic), include but are not limited to:

- field sampling notes;
- field and laboratory analytical records for sample transfer, preparation, and analysis;
- chain-of-custody records;
- data reports, including analytical results forms;
- laboratory QC/QA documentation;
- data validation records; and
- communication records.

The PM or PQAM, as applicable, is responsible for confirming that this documentation is retained in the project file.

6.3 Peer and Senior Review Documentation

The requirements for documenting project-specific peer and senior reviews are described in Sections 3.9 of this QMP. The PD and PM may use the review forms in Appendix A of this

QMP for documenting peer and senior reviews. The documented results of project peer and senior reviews are retained with the project files.

6.4 Management Assessment Documentation

The results of QMS management assessments and project-specific management assessments are maintained in the company QMS corporate file. The CQAM is responsible for the completeness and maintenance of these files.

6.5 Project Document Control Systems

For projects where multiple copies of a document will be utilized by multiple parties in the field (e.g., field investigations and construction projects), and/or where project documents are potentially subject to revision, the PD evaluates the need to implement a formal document control system. The purpose of such systems is to assure that all parties at all times are using the same proper approved revision of a document. When a document control system is established, the PM will designate a member of the project team as the project document controller. This individual will establish a controlled document tracking and status report to track each controlled document and the status of revisions to documents.

6.6 Data Archives

Project data should be archived so that it is secure and retrievable. Data archives may be in paper format, digital format, or both. Data archives are accompanied by documentation that describes the hardware and software used to read and write the archives (for digital format), the information stored in the archives, the format of the information, the date and location under which the information was collected, the laboratory involved in generating the information, and other information that may inform the user about the nature, quality, or use of the data. Data should be archived in such a way that the records will not be degraded and made unusable over the timeframe which the data must be maintained (see Section 13 of the RMP). Records are stored in secure locations with controlled access and adequate temperature control to maintain their integrity.

7. COMPUTER HARDWARE AND SOFTWARE

7.1 Information Management System

Geosyntec's information management system incorporates a number of network and computer hardware and software systems. The firm's Information Technology Department (IT) is responsible for identifying the company's information technology system needs, selecting and procuring system components, general system operation and maintenance, system integrity and security, and system planning.

For procuring network hardware and software, IT evaluates the performance, quality, and cost attributes of available hardware and software, assesses its usability, makes a purchase recommendation, and then integrates the new hardware and software into company use. IT assesses and documents the impact of changes to user requirements and/or performance using the process described below:

As appropriate, IT requests the product from manufacturers for the purpose of beta testing. If the product is commercially available and manufacturer-approved, beta testing typically does not exceed 60 days.

- New products are tested against existing computing systems to ensure compatibility, while assessing the risks associated with the use of the technology and ensuring that specific product process goals and objectives are met as expected.
- IT prepares a documented project plan prior to implementing the product for general use. Depending on the complexity of the product, documentation and/or training may be used to introduce the product for use.
- IT provides training, which may include self-help documentation, on line materials including manufacturer-provided interactive training, and individual one-on-one sessions.
- IT maintains relevant documentation and materials supporting the technology. Sensitive procedures, checklists, documentation, and related resources are stored in a secure location (e.g., license keys). End user-related materials are made readily available on the Geosyntec intranet and are updated by the IT lead when changes are made.

The IT Director is responsible for the management of IT operations and functioning support teams within the department. The IT Director is also responsible for maintaining good communications with employees of the firm, and provides for additional technical support or makes recommendations as needed.

7.2 Selection of System Hardware and Software

The process IT uses for selection of system hardware and software includes evaluation of:

- goals and objectives of intended software/hardware;
- business requirements and intended benefits of the software/hardware;
- an existing commercial solution, if a replacement/upgrade is in order;

- a proposed new solution;
- risks which may be associated with the product; and
- the total cost of ownership including maintenance, recurring or additional costs, and other budgetary considerations.

IT obtains input and recommendations from approved vendors, with a preference to utilize top-tier manufacturers to ensure stability in the marketplace, lower risks, and better compatibility with existing and potential future system features. Consideration may be given to proprietary technology sources as driven by business-specific needs. Where available, IT requests actual product reviews from manufacturers.

7.3 Selection of Project Software

Geosyntec personnel use software in a variety of ways on projects. These include, but are not limited to, database software, geographic information systems (GIS) software, visualization software, analysis and modeling software, laboratory or field test interpretation software, design software, and computer-aided drafting and design (CADD) software. The following guidelines apply to the selection of this practice software:

- the software is in the public domain and is accessible free or for purchase by others; proprietary software may be used, but only when specifically approved by the PD and the client;
- the software must be approved for general use by the appropriate Action Group Steering Committee;
- IT must approve the software as suitable for use on Geosyntec's IT system;
- the software is appropriately licensed to Geosyntec, and we have access to users' manuals and other software documentation; this documentation must be sufficient to enable Geosyntec personnel to proficiently use the software;
- the software's performance has been validated by the developer and/or third-party reports and publications; and
- the version of the software being used is the most up-to-date version, or, if an older version is being used, the user documents that the older version is suitable for use and the changes in the newer versions do not make the older version obsolete.

7.4 Use of Project Software

The use of software on projects must be done in accordance with applicable developer guidance and the standard of care for such software use in the profession. Software should only be used where the PM has confidence that the software is suitable and tested/validated for the intended use, and the project team has the expertise and experience to appropriately use the software. Specific additional guidelines are as follows:

- the PM has established that the project team member assigned to use the software has the appropriate training and experience to use the software;
- the project team has another designated member with the training and experience necessary to provide peer review of the software application process, including as may be applicable, data inputs, initial and boundary conditions, simulation details, calibrations, and results;
- only data inputs that have undergone QC/QA appropriate to that data should be used in project software applications; and
- as appropriate, software users should evaluate their analysis, modeling, and simulation outputs for reasonableness and suitability by comparing the output to known solutions or similar case studies, by assessing the computational stability of the results, and by performing parametric/sensitivity analyses as may be appropriate.

7.5 Data Standards

On some projects, specific data standards may be imposed by regulatory or client requirements. For example, some clients and regulatory agencies require the submittal of site characterization and monitoring data in a prescriptive database format. It is the responsibility of the PM or PQAM, as applicable, to be aware of client and regulatory requirements, and to communicate those standards to project staff, and, if needed, to the IT Director or branch level IT representative.

8. PROJECT PLANNING

8.1 Systematic Planning Process

The PM has the primary responsibility for implementing a project planning process that involves, as applicable, the client, PD, project task managers, PQAM if applicable, project personnel, health and safety personnel, subcontractors and suppliers, regulators, and other stakeholders. These participants are involved, as appropriate, during the preliminary planning process to address scope, schedule, technical, safety and administrative issues early in the project.

The project planning process often begins with the development of a written proposal that describes the project objectives, scope of work, technical and logistical assumptions, limitations, health and safety considerations, schedule, and budget estimate. In accordance with the RMP, the proposal is internally reviewed and approved by the PD. The number of personnel involved in the production and review of the proposal is commensurate with the size and complexity of the project.

If Geosyntec is selected by the client to perform the proposed project, the planning process is advanced beyond the proposal stage. The project objectives, scope of work, technical and logistical assumptions, limitations, schedule, health and safety plan, and budget are all updated to reflect proposal addenda, additional discussions with the client (which should be documented in writing), new information, and the contract terms and conditions. Geosyntec has established the Work Flow Guidance to help PMs and project staff in the systematic planning process and in the systematic project execution that follows. The Work Flow Guidance is presented in Appendix A of this QMP.

8.2 Project Schedule, Budget and Staffing

It is the PM's responsibility to develop a plan to meet the project schedule and budget requirements. Project deliverables and deliverable dates are developed in conjunction with the client and other project team members. The PM develops a project staffing plan to meet these requirements.

8.3 Data Collection Planning Process

As part of the planning process, the PM and project team must identify what data will need to be collected and the methods to be used for data collection. The data collection methods, types of data collected, and intrinsic level of data quality will depend on the project objectives. The planning process also involves consideration of where data collection will be addressed (i.e., in the project proposal, work plan, QAPP, or other project-specific documentation). The project planning process should also identify how data will be managed (e.g., hard copy, database, GIS), the QC/QA procedures that will be applied to the data, and the data presentation formats (e.g., summary information, spreadsheets, tables, trends and statistical parameters, graphs).

Sometimes, data are available on projects that were generated at an earlier time for similar or different purposes as the current purpose, with similar or different sampling and analysis methods, and similar or different quality objectives. These types of data are termed "secondary

data." The use of secondary data which were not generated for the same purpose or with the same quality objectives as the current project may lead to inadequate findings or conclusions. It is essential as part of the project planning process to identify use limitations for secondary data. This process should be performed relative to the project DQOs and other project-specific requirements.

8.4 Identification of Required QA and QC Protocols to Meet DQOs

As part of the project planning process, the PM should consider the application of informal, prescriptive (e.g., ASTM procedures), or project-specific consideration should be given to establishing DQOs, as discussed in Section 3 of this QMP.

8.5 Project Work Plans and QAPPs

As described in Section 2. of this QMP, the primary responsibility for QC/QA input to the project work plan, and for establishing a project QAPP when the PD identifies the need for one, resides with the PM. For smaller, less complex projects, QC/QA requirements may be described in a memorandum or other form of documentation.

Work plans, QAPPs, memoranda, and/or related documentation are prepared for the use of the project team and, as appropriate, subcontractors and suppliers. On some projects, these planning documents may need to be submitted to a regulatory agency (such as EPA) for review and approval. Approved QAPPs for ongoing (greater than a year in duration) programs or projects are reviewed, and revised if necessary, on an annual basis, or more frequently if there are changes in project scope, personnel responsibilities, or QC/QA requirements.

9. IMPLEMENTATION OF WORK PROCESSES

9.1 Overview

The PM is responsible for confirming that project activities are performed according to the approved scope of work (as reflected in the work plan or other documentation that describes the required work), contractual requirements, and other applicable requirements and guidelines, as previously discussed. The PM is also responsible for tracking of project scope, health and safety performance, schedule, and budget. Project task managers may be assigned at the discretion of the PM, depending on the size and complexity of the project. It is the responsibility of the PD to confirm that the PM is fulfilling these responsibilities. The company has established Work Flow Guidance assist PMs and project personnel in systematically planning and implementing these activities.

9.2 Standard Operating Guidelines: Development and Use

An SOG is developed to provide practice-specific guidance as described in Section 3. SOGs can be adopted or modified from guidelines published by federal and state agencies and standards development organizations, such as EPA, FERC, NRC, COE, the United States Geological Survey (USGS), the U.S. Federal Highway Administration (FHWA), and the American Society for Testing and Materials (ASTM). A SOG can also be developed internally by Geosyntec.

The AGQAM prepares or directs preparation of SOGs. Each SOG is peer reviewed and must be approved by the Action Group Steering Committee and CQAM. Each AGQAM is responsible for revising existing SOGs, developing new SOGs, and deleting obsolete SOGs.

9.3 Standard Operating Procedures: Development and Use

Project-specific SOPs may be developed to reduce potential variability in the execution of tasks that are critical to meeting project DQOs. The PM, in conjunction with the PQAM when applicable, identifies the need for project-specific SOPs for critical and/or repetitive technical and administrative tasks that are important in satisfying project objectives. SOPs for the project are a part of, or referenced in, the project-specific QAPP, work plan, or task descriptions.

Existing approved SOGs may be designated as SOPs on a project-specific basis. The PM or qualified designee (e.g., senior project personnel) may also develop project-specific SOPs where there is no suitable existing SOP. In either case, the PM, or PQAM when applicable, should review the SOP for suitability for the specific project.

The PM is responsible for ensuring that the processes described in project-specific SOPs are followed and implemented as written, and that project personnel using SOPs are appropriately trained.

10. PEER AND SENIOR REVIEWS

10.1 Peer Reviews

The peer reviewer(s) for project tasks and activities is (are) selected by the PM. Peer reviews may be performed on tasks involving work plan preparation; information/data collection; data management, interpretation, and use; analytical and numerical modeling and analysis; study design and implantation; engineering design; preparation of plans and specifications; preparation of construction bid packages; and preparation of operations and maintenance plans.

Action Groups may prepare and utilize a SOG or other form of documentation acceptable to the CQAM to provide peer review guidance for the tasks and activities conducted by the group (e.g., peer review of calculation packages). The AGQAMs collaborate with each other on technical review SOGs so as to minimize duplication of effort and to share review processes that have proven successful. Documentation of Peer Reviews is completed on the QMS Website and file copies are retained on the QMS SharePoint site. The InfoPath forms include the material to be reviewed, the name of the person(s) who prepared the material to be reviewed, confirmation by the reviewer(s) that review comments were addressed and resolved. This documentation from the completed peer review is retained on the QMS SharePoint site and may also be retained in the project file.

10.2 Senior Reviews

As described in Section 3, the senior review process is conducted by the PD (or designee) throughout the duration of the project. The purpose of senior review is to confirm that the project scope, schedule, budget, and health-safety requirements are achieved, that project-related requirements of the RMP and QMP have been addressed, and that the project has been performed in accordance with the applicable standard of professional care. Senior review begins at the proposal stage, proceeds to the evaluation of work plans, and continues with periodic reviews conducted throughout the duration of the project. As discussed in Section 3, senior review also includes document reviews as work products are produced for delivery. Document reviews should be undertaken for all of the types of documents identified in Section 11 of the RMP. The senior review process is also intended to assure that the project file is complete and in accordance with Chapter 13 of the RMP and that all necessary peer review documentation is in the project file. The InfoPath forms include the project and report or material reviewed, the name of the project manager, the name of the senior reviewer (if a designee), and the name of the PD approving the senior review. This documentation from the completed senior review is retained on the QMS SharePoint site and may also be retained in the project file.

11. MANAGEMENT ASSESSMENT AND RESPONSE

11.1 Assessment of the Quality Management System

The scope of QMS management assessments was described in Section 3 of this QMP. These assessments are intended to identify compliance with QMS requirements and opportunities for improvement. The CQAM is responsible for conducting the assessments under the direction and review of the RMC. The CQAM may engage the AGQAMs for those parts of the assessments and associated SOGs and SOPs. The CQAM leads the overall assessment and communicates the results to the RMC. If changes to the QMS are necessary as a result of the management assessment, the Work Flow Guidance, QMP, and other quality related documentation and training programs are revised, as appropriate.

The results of each QMS management assessment are documented in an assessment report that is prepared and signed by the CQAM. The objective of the report is to communicate assessment results and recommendations to the RMC and senior management responsible for implementing timely, effective response actions, so that quality objectives are met.

11.2 Project Assessments

Management assessments of individual projects may occur on active projects or on projects that have been completed. The PD or CQAM may initiate a management assessment of a specific project. As described in Section 3, management assessments of projects may be performed by the PD or by a qualified individual independent of the project team. Assessment criteria are established based on the project scope of work, contract, and QAPP, as applicable. Assessment tools may include internal and external audits, data quality assessments, senior reviews, and technical systems reviews. In selecting assessment tools, the assessor evaluates applicable statutory and regulatory requirements, as well as requirements stipulated by the contract.

Project-specific management assessments are documented, signed by the assessor, and provided to the CQAM for review and action, as appropriate. The CQAM holds a meeting (in person, by telephone, or via the internet) with the PD and PM to discuss the assessment results. The CQAM maintains a copy of the project-specific management assessments in the company QMS files. The assessment results are not included in the project file. The detail and formality of the assessment documentation is commensurate with the size and complexity of the project.

11.3 Corrective Actions

For assessments at the system level (e.g., assessments of the QMSand QMP), the CQAM is responsible for identifying and implementing corrective actions. For QMS non-conformances, the assessor prepares a Corrective Action Memorandum (CAM) identifying the non-conformance, including objective evidence. Root cause(s) for the non conformance should be identified by the assessor prior to proposing a corrective action. Corrective actions should be implemented in a timely fashion. The assessor verifies the corrective action, and CAMs are retained in company QMS files.

For assessments at the project level, the PM or PQAM, as applicable, is responsible for implementing corrective actions identified by the assessor. Corrective actions are documented, and this documentation is kept in the company QMS files.

All company staff are encouraged to make suggestions for corrective actions to improve the QMP and Work Flow Guidance. Company staff with suggestions may bring them to the CQAM or AGQAM, as appropriate, for discussion and consideration. The CQAM or AGQAM may then work with the company staff for preparation of a CAM to improve the company's QMS.

11.4 Documentation and Tracking

The specific requirements for documenting QMS assessments (i.e., content and format) and for tracking corrective actions are developed by the CQAM. Assessment documentation includes:

- planning information, including the criteria for the assessment;
- checklists for collecting and recording objective evidence;
- assessment summary matrix; and
- CAMs.

11.5 Issue Resolution

If issues arise as a result of an assessment and related response, the issue resolution process outlined in Section 2 of this QMP applies.

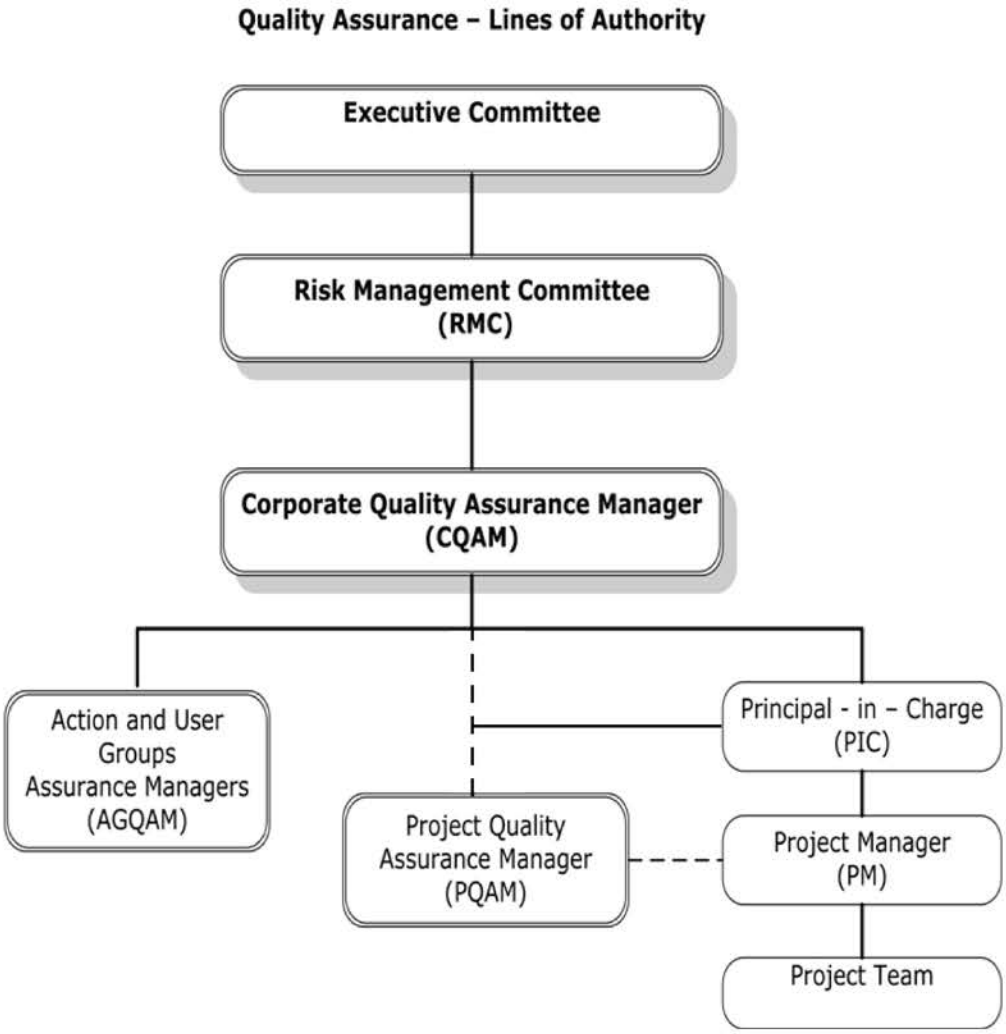
12. QUALITY IMPROVEMENT

The Geosyntec QMS is a dynamic set of policies, procedures, and guidelines that is intended to encourage ongoing quality improvement throughout the organization. Through the assessment and corrective action processes, the QMS corrects systematic problems, improves consistency, enhances individual system components, re-engineers ineffective work processes and procedures, and customizes quality tools. Through review of project assessments, management and staff are encouraged to establish communications among themselves and with clients and subcontractors to explore opportunities for improved service and quality.

Every employee is encouraged to identify conditions that are adverse to quality and to suggest improvements to the Quality Management System. This can be done through the corrective action process. When deficiencies or shortcomings in the QMS are identified, project personnel should promptly complete a CAM for submittal to the appropriate PM or QAM for review and action. Project team members are also encouraged to use the CAM for subcontractor and supplier process improvements.

On a periodic basis, the CQAM reviews the QMP. The CQAM communicates the results of the review to the Executive Committee and RMC, as appropriate, to identify opportunities for quality improvement. Based upon the review, the CQAM recommend and make changes to the QMS documents. All modification of the approved QMS documents will be made under change control procedures so staff are aware of the current and approved QMS procedures and documents.

Figure 1


Quality Assurance – Lines of Authority
Executive Committee
Risk Management Committee (RMC)
Corporate Quality Assurance Manager (CQAM)
Action and User Groups Assurance Managers (AGQAM)
Principal - in – Charge (PIC)
Project Quality Assurance Manager (PQAM)
Project Manager (PM)
Project Team

APPENDIX A

Review Forms

- Senior
- Peer

Geosyntec consultants

SENIOR REVIEW FORM

This section to be filled out and signed by the Project Manager.

Client:_____ Project:_____ Project No.:_____ Task No.:____
Project Manager:_____ Principal-in-Charge:_____
(Printed Name) (Printed Name)
Document Title: _____
I received comments from the Reviewer. I state that all important issues raised by the Reviewer were resolved.

_____ _____ _____
(Printed Name of Project Manager) (Signature of Project Manager) (Date)

This section to be filled out and signed by the Senior Reviewer.

I received relevant portions of the proposal/contract to understand the required scope of services. ..... ☐ Yes ☐ No
I reviewed the document. ..... ☐ Yes ☐ No
I gave a copy of the document with my comments to the Project Manager..... ☐ Yes ☐ No
I filled out a Document Preparation Checklist and gave it to the Project Manager *(Not required)* ... ☐ Yes ☐ No
I gave comments orally to the Project Manager..... ☐ Yes ☐ No
I confirmed that my comments were adequately resolved. ..... ☐ Yes ☐ No

My conclusions are:	**Not Applicable**	**Reviewer's Initials**
1. The scope of the document is consistent with the required scope of services.	☐	_____
2. The document's organization and clarity are satisfactory.....	☐	_____
3. The document presentation is satisfactory.	☐	_____
4. The assumptions and approaches are technically appropriate.	☐	_____
5. The technical components of the document (e.g., calculations, drawings, tables, figures, test results, test interpretations, specifications) have been checked (i.e., peer review has been performed).....	☐	_____
6. The conclusions, judgments, and recommendations are adequate.....	☐	_____
7. Assumptions, approximations, uncertainties, and limitations are clearly stated.....	☐	_____
8. The document is consistent with the Project Policies section of the company Risk Management Program.	☐	_____

_____ _____ _____
(Printed Name and Title of Reviewer) (Signature of Reviewer) (Date)

If the Reviewer is not the Principal-in-Charge, signature of the latter is required.

_____
(Signature of Principal-in-Charge) (Date)

Geosyntec consultants

PEER REVIEW FORM

Client: _____ **Project:** _____ **Project/ Proposal No.:** _____ **Task No.:** _____

Title of Computations / Technical Interpretations: _____

Computations / Technical Interpretations by:

Signature _____ Date _____

Printed Name and Title _____

Assumptions and procedures checked by:

Signature _____ Date _____

Printed Name and Title _____

Computations / Technical Interpretations checked by:

Signature _____ Date _____

Printed Name and Title _____

Computations / Technical Interpretations backchecked by: (Originator)

Signature _____ Date _____

Printed Name and Title _____

Approved by: (PM or designate)

Signature _____ Date _____

Printed Name and Title _____

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Program Quality Management Plan (QMP)

November 21, 2017

Reviewed by:

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Quality Assurance Manager

11/21/2017
Date

Approved by:

Don McHugh
Program Manager

11/21/2017
Date

Reviewed by:

J. Mark Owens
President, ACTenviro Federal Services

11/21/2017
Date

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Figure

1 Quality Organization Chart

1.0 Introduction

The primary goal of this Program Quality Management Plan (QMP) is to ensure that ACTenviro's (ACT) environmental projects and decisions are supported by chemical data and records that are technically sound, valid, and properly documented. This QMP is designed to be usable and helpful to ACT's environmental team and management and will be distributed as required reading for all team members. This quality program incorporates quality policy elements with designated lines of authority and responsibility for all project personnel.

This QMP is intended to document ACT's programmatic quality assurance (QA) policy and to:

- Ensure that ACT meets U.S. Environmental Protection Agency (EPA) QA requirements as defined in *EPA Order 5360.1, A2* (EPA, 2000a), and *EPA Requirements for Quality Management Plans* (EPA, 2001a);
- Implement a quality system that guides QA planning and execution for individual projects and provides an appropriate level of QA review for each environmental project;
- Ensure that continuous improvement is practiced at all organizational levels in the implementation of this programmatic quality system; and
- Ensure that adequate resources (including internal labor, subcontract support, travel, and training) are provided to implement this policy.

1.1 Management and Organization

This QMP addresses the performance of environmental activities, and is applicable to all of ACT. This document has been tailored to support planned activities scoped for various projects. ACT is managed by Mr. Walter Singer, and individual task orders issued to ACT are managed by Mrs. Tobi Moore.

1.2 Quality Assurance Policy

The Federal Services group is committed to ensuring the:

- Integration of ACT's quality program into management policies and project practices;
- Development of and adherence to a QA program that promotes sound science, consistency, efficiency, communication, responsiveness to customers, and innovation;
- Adherence to a systematic planning process that results in the generation and use of environmental data of the type, quantity, and quality needed for decision making;
- The use of Quality Assurance Project Plans (QAPPs) and/or standard operating procedures (SOPs) in project-specific data collection;
- Design, construction, and operation of environmental technologies that meet established specifications; and
- Provision of funding and resources needed to accomplish the defined quality objectives.

2.0 Quality Assurance Roles and Responsibilities

ACTs QA organization is presented in Figure 1. The organizational structure is designed to maintain the required independence and authority of the QA Manager. These roles and responsibilities are described in additional detail in the following subsections.

2.1 Environmental QA Manager

The QA Manager is responsible for:

- Leading the ACT in communication of QA policies and procedures;
- Reviewing and approving this QMP;
- Reviewing and approving site-specific QAPPs;
- Coordinating agency review of QAPPs and resolving any policy or project issues with the reviewer;
- Ensuring compliance with EPA directives for the collection of environmental data;
- Ensuring compliance with QAPPs and/or SOPs in project-specific data collection;
- Conducting QA audits of various Environmental Department functions (planning document preparation, fieldwork, sample collection, field data documentation, laboratory analyses) for compliance with appropriate procedures and to ensure that project decisions are supported by data of the type and quality needed and expected for their intended use;
- Oversight of the environmental database, which is the repository of the department's lithologic and chemical data;
- Initiating discussions and taking required action with Project Managers to correct quality problems;
- Informing Project Managers of any emergent QA issues with proposed resolution;
- Serving as arbitrator for quality issues that cannot be resolved at lower levels;
- Reporting all unresolved QA issues to the Program Manager;
- Identifying QA training needs and ensuring that these training needs are satisfied; and
- Leading continuous quality improvement efforts within ACT.

The ACT QA Manager is Mr. Jesse MacNeill

2.2 Environmental Program Manager

The ACT Program Manager is responsible for:

- Ensuring that ACT's quality policy is implemented by including quality responsibilities as described in this QMP in the performance standards of all members of the Environmental team;
- Promoting by words, action, and involvement, the establishment of a quality culture at ACT;
- Promoting by words, action, and involvement continuous quality improvement within ACT;

- Providing facilities that are conducive to the production of data of appropriate quality to meet the needs of the projects being executed;
- Providing adequate resources (including internal labor, subcontract support, travel, and training) to support ACT's quality requirements;
- Reviewing and approving this QMP; and
- Serving as the ultimate decision maker on unresolved quality issues.

The ACT Program Manager is Mrs. Tobi Moore.

2.3 Environmental Project Managers

The Project Managers are responsible for:

- Overall coordination and supervision of the work performed on their project(s),
- Project planning and execution in accordance with EPA policy and guidance;
- Directing and documenting field decisions in accordance with project-specific QAPP or other applicable planning document with the goal of producing defensible data of defined quality;
- Ensuring that field practices are compliant with SOPs and maintaining project documentation sufficient to enable the complete and accurate recreation of the project for reporting purposes;
- Ensuring that field equipment is operated properly and in accordance with manufacturer's directions, that instruments are properly calibrated and that calibration is documented;
- Conducting data quality evaluation, interpretation, and report preparation;
- Ensuring the integrity of all project data collected (including chemical, lithologic, geospatial, hydrologic, and other) and the appropriate archival of that data, whether in ACT's database, project files, Geotracker, project website, or other;
- Assessing status of training on project team to ensure compliance with applicable policies; and
- Promoting and implementing continuous quality improvements on each project.

The ACT Project Managers include Mr. Jacob Blanton (PSC) and Mr. Hunter Butler.

3.0 Quality System Principal Components

ACT's QA system integrates several components in its operation. Principal components are discussed in the following subsections.

3.1 Environmental QMP

This QMP documents ACT's quality system and encompasses the management and technical activities necessary to plan, implement, and assess the effectiveness of QA and QC operations applied to environmental projects. This QMP will be reviewed, approved and signed by ACT's Program Manager and QA Manager. It will be reviewed annually and updated as needed. The approved QMP will be valid for five years unless there is significant change in organization. After five years or a significant change, the QMP is reviewed and revised as needed and subjected to the same review and approval process described above. The approved QMP will be submitted to teaming partners as required by subcontract terms.

3.2 Sampling and Analysis Plans

One of the central components of the Quality System is the project-specific QAPP. The purpose of the QAPP is to assure that the data collected during the project are precise, accurate, representative, complete, and comparable, and that they meet the criteria of technical project procedures during sample collection, sample analysis, and data evaluation. The QAPP identifies project-specific data quality objectives, stipulates a set of processes, procedures, and inspections that govern the project execution, and is customized for the specific requirements of the individual project. Project-specific QAPPs are prepared in accordance with applicable guidance from the EPA (U.S. EPA, 2000b, 2001, 2002 and 2005).

The EPA will review and approve QAPPs for each project. ACT's QA Manager will work with the EPA to ensure that concerns are resolved expediently, and that project work does not proceed until the QAPP is approved. The QA Manager will conduct periodic QA audits to ensure that fieldwork and data collection are conducted in accordance with the approved QAPP.

3.3 Standard Operating Procedures

The purpose of the SOPs is to facilitate the uniform performance of routine procedures. ACT has developed SOPs for routine or repetitive operations, including low-flow groundwater sampling operation, soil sample collection, and trench excavation and soil sampling, which are used for more than one project or performed by more than one person. Before implementation, SOPs are reviewed by a second person with experience in the area, and by the QA Manager.

SOPs are recommended for special activities or critical operations. Project-specific SOPs may also be written, and are particularly useful for facilitating documentation updates or when project work is being supported by subcontracted personnel.

3.4 Equipment Manuals

Equipment used for the measurement or collection of environmental data will be operated in accordance with manufacturer's directions. This applies to equipment inspection, calibration, operation, and maintenance. If conditions necessitate a deviation from manufacturer's direction, the deviation will be documented in the field logbook or project files, with supporting rationale and a discussion of potential impact on data quality.

3.5 QA Audits

ACT's audit program is designed to evaluate the capability and performance of a measurement system or its components, and identify problems that warrant corrective action. Three types of audits may be conducted, at the discretion of the ACT QA Manager, or Program Manager: performance, system, and field audits. Auditors will be independent of the data collection activities and may be selected by the QA Manager. Technical expertise and experience in auditing will be considered in selecting an auditor or audit team. Audits are discussed in further detail in Section 6.

3.6 Data Quality Management

Review of project data will be performed periodically, and at critical project junctures, and will include an assessment to determine whether all required data collected are present, accurate, and complete. Data quality reviews may be initiated by the QA Manager, Program Manager, or Project Manager.

3.6.1 Field Notebook and Hard Copy Data

Field notes and other project documentation will be reviewed for clarity, completeness, and compliance with the QAPP. Data collected during field investigations will be recorded in a field logbook or on the appropriate data collection forms.

A controlled, bound field notebook will be used to document daily activities and record details such as weather conditions, boring locations, sampling events, and site conditions. All entries to the field notebook will be made using waterproof ink and will be signed and dated. Errors in the field notebook will have a single line drawn through them, and the correct information will be entered above. Custody of the field notebook and data collection forms will be the Project Manager's responsibility during the duration of the fieldwork. When fieldwork is completed, the field notebook will become part of the project file.

3.6.2 Laboratory Data

Chain-of-custody forms, sample results, required QC information, case narratives will be reviewed for quality. Additionally, the initial review will determine if results are reported for all samples on the subject chain-of-custody for the analytical parameters specified, unless laboratory sample discrepancy reports provide adequate explanations for omissions. Data quality reviews will be conducted to assess compliance with EPA guidance (EPA, 2000c).

Fixed laboratory data generated under this subcontract will be subject to two levels of review within the laboratory. A chemistry supervisory-level review will be completed to verify analyte

identification, quantitation, and QC data. Evidence of that review will be maintained in the form of a checklist outlining method and project requirements. The Laboratory Project Manager will work with the Laboratory QA/QC Manager to review all results, investigate QC outliers and anomalies and potential noncompliance with project requirements.

If needed, the data should be able to serve as a legal record of the field activities conducted. Laboratory QA/QC Manager and ACT QA Manager will ensure in order to serve these purposes, all of the following verification criteria are met:

- Sample ID, date, and time of sample collection – required to uniquely identify sample and assess holding time compliance.
- Location of samples, including depth, if appropriate – required to uniquely identify samples (these data will be provided in the field notebook).
- Chain-of-Custody documentation – required to demonstrate integrity of samples and maintain unique identity of samples. It includes a unique sample identification number, sample collection date and time, and signature of the persons relinquishing and receiving the sample.
- Field QA/QC sampling – required to demonstrate sample integrity; it includes field decontamination procedures to prevent cross-contamination, the collection of field blanks, and the collection of duplicate samples during each sampling activity.
- Name and location of laboratory – required for chain-of-custody documentation and to verify credentials of laboratory.
- Analytical methods – required to assess appropriateness and acceptability of analytical methods used and to determine holding times.
- Detection limits – required to assess the lower limit of parameter identification.
- Holding times, and dates of extraction, analysis and preservation – required to assess whether the samples were extracted and analyzed within the holding time required.
- Laboratory QA/QC procedures – required to assess analytical accuracy and sample integrity. Spikes, duplicates, method blanks, and surrogates for each analytical batch are to be analyzed by the laboratory at appropriate frequencies.

Discrepancies resulting from the data review will be addressed as an uncertainty in the decision-making process.

3.6.3 Data Verification

Field and laboratory data will be subject to verification prior to inclusion in a project database or presentation in a report. Data will be verified using both manual and electronic procedures. Data stored, evaluated, and reported electronically will be subject to 100 percent manual verification against hard copy reports. Project personnel will verify field data collected during field investigations by daily review of documentation for accuracy, precision, and completeness. Any errors or inconsistencies will be resolved immediately by clarifying the issue with the appropriate field personnel. All field personnel will be responsible for following the sampling

and documentation procedures described in the project-specific QAPP. Upon receipt, laboratory electronic data will be reviewed to ensure that results for all samples and analyses are reported. Following data review, data verification will be conducted to ensure that the electronic data deliverable is consistent with the hard copy report submitted by the laboratory, and to identify irregularities in analyte identities, concentrations, and units.

Any discrepancies encountered as a result of this review will be corrected or reconciled before the data is uploaded into the project database. The uploaded data will also be processed to compare the fields against a list of required values. If any errors are identified, the file will be manually edited or regenerated by the laboratory. If no errors are identified, the data will be uploaded into the database. The laboratory database will be merged with the field database and reports will be generated from the merged database. All required CERCLA related electronic data will be transmitted in the format specified in project-specific QAPPs.

4.0 Personnel Qualifications and Training

It is ACT's policy that persons managing or directing environmental projects have appropriate training for their assigned work. Training needs may be assessed by EPA regulation or guidance, by those persons planning a technical activity, or by those team members managing a technical activity. The process for specifying and documenting training varies by training type. Some of ACT's training is described in the following subsections.

4.1 Technical Training

Documentation of technical training may be an appropriate degree in an area of study. Other documentation of technical training may include professional registrations (e.g., Professional Geologist or Professional Engineer) or certification of specialized training (e.g., instrument operation as provided by technology vendors). Registration ensures the public that those individuals licensed and certified have met defined levels of education and experience. Other project-specific specialized training requirements may be described in the QAPP document, as established by the Program Manager or QA Manager.

4.2 Quality Management Training

ACT's QA Manager is required to maintain currency with relevant EPA policies. The QA Manager conveys current policy directives to the Team during weekly staff meetings.

4.3 Safety Training

ACT environmental personnel working on hazardous-waste project sites are required to have specific training before participating in, managing, or supervising field activities. Personnel who work at a hazardous-waste site are required to meet the health and safety training requirements of Title 29 Code of Federal Regulations (29 CFR) Part 1910.120(e).

ACT environmental personnel engaged in activities that expose or could expose workers to hazardous substances and health hazards at a hazardous-waste site will receive a minimum of 40 hours of HAZWOPER training and a minimum of 3 days of actual field experience on site under the supervision of a trained, experienced field supervisor. Employees engaged in work at hazardous-waste sites also undergo 8 hours of annual refresher training to maintain regulatory compliance.

Documentation of health and safety training records, including course completion certifications for the initial health and safety training and refresher training, will be maintained by ACT's Health and Safety Manager and/or Human Resources Manager.

5.0 Documentation and Records

This section describes ACT's QA policies with regard to documentation and record maintenance. The record management policy includes paper, electronic, audiovisual, and web-based media, and is designed to ensure that records accurately reflect completed work and/or fulfill statutory and contractual requirements.

Documents such as this QMP, QAPPs, and SOPs are prepared, reviewed, approved, issued, and implemented. These documents, and any revisions to them, must be reviewed for conformance with ACT's QA requirements and approved by the QA Manager prior to general use.

5.1 Project Data and Documentation

Archival of project-specific data and documentation is the responsibility of the Project Manager. The level of documentation maintained on a project is dependent on the type of project, and is typically detailed in the QAPP. When a project is completed, the project file is archived as part of task order closeout. The Project Manager is responsible for ensuring that the project file is complete, and includes all necessary contractual, technical, deliverable, and miscellaneous submittals (such as calculation packages, data verification files, photographs, boring logs, etc). Project data, deliverables, and records will be archived at ACT's Corporate office at 1210 Elko Drive, Sunnyvale, California.

5.2 Laboratory Data

A full data package will be required from laboratory subcontractor(s) which will be prepared in accordance with the instructions provided in the EPA Contract Laboratory Program (CLP) statements of work (EPA, 2017a & 2017b). The laboratory will maintain all relevant raw data and documentation, including but not limited to logbooks, data sheets, electronic files, and final reports, for at least 7 years. ACT will be notified 30 days before disposal of any relevant laboratory records.

ACT will maintain copies of all COC forms until receipt of the laboratory report. One copy of the laboratory report will be logged in upon receipt and maintained in ACT project files.

5.3 Electronic Data

Electronic data (including source data from analytical laboratories, survey subcontractors, GPS files, etc) will be maintained by the Project Manager in a project directory on a secure server. Electronic data will be backed up periodically to mitigate risk of loss or compromise.

6.0 Performance Assessment and Corrective Action

Assessment audits may include reviews of project plan adherence, training status, health and safety procedures, activity performance and records, budget status, QA data, calibrations, and conformance to SOPs. Audits may also review compliance with laws, regulations, policies, and procedures. After an audit is completed, the auditor will review results with the project team and will submit the audit report to the project file. The QA Manager will coordinate a management review of any deficiencies that are noted and initiate any required corrective action. The auditor is responsible to verify that any required corrective actions are completed.

6.1 Laboratory Performance Audits

Contracted laboratories must be certified by the State's Environmental Laboratory Accreditation Program (ELAP) Board. A laboratory performance audit is a review of the existing project and QC data to evaluate the accuracy of a total measurement system or a component of the system. ACT may conduct laboratory performance audits before samples are submitted to the laboratory for analysis.

6.2 System Audits

A system audit is used to verify adherence to QA policies and SOPs. This type of audit may consist of on-site review of measurement systems. In addition, procedures for measurement, QC, and documentation may be evaluated. The first system audit is conducted shortly after a system becomes operational and on a regularly scheduled basis thereafter.

6.3 Field Audits

A field audit involves an on-site visit by ACT's QA Manager or designated audit team. Items to be examined include the availability and implementation of approved field procedures, instrument calibration and operation of equipment, chain-of-custody procedures and instructions, and nonconformance documentation. The EPA may also conduct a field audit of this project, addressing the items described above.

6.4 Corrective Action Procedures

An effective QA program requires prompt correction of non-conformance conditions that affect quality. Rapid problem identification and prompt, effective corrective action reduce the possibility that questionable data or documentation will be produced. Two types of corrective actions exist: immediate and long-term. Immediate corrective actions include correction of documentation deficiencies or errors, repair of inaccurate instrumentation, or correction of inadequate procedures. The source of the problem can usually be corrected at the time it is observed. Long-term corrective actions can include correction of systematic errors in sampling or analysis, and correction of procedures producing questionable results. Corrections can also be made through additional personnel training, instrument replacement, or procedural improvements.

All QA problems and corrective actions will be documented to provide a complete record and help to identify needed long term corrective actions. Defined responsibilities are required for scheduling, carrying out, documenting, and ensuring the effectiveness of the corrective action. The following two sections describe the corrective action procedures to be followed in the field and laboratory.

6.4.1 Field Procedures

Field nonconformance conditions are defined as occurrences or measurements that are either unexpected or that do not meet established acceptance criteria and will affect data quality if corrective action is not implemented. Examples of nonconformance include issues such as:

- Incorrect use of field equipment
- Improper sample collection, preservation, and shipment procedures
- Incomplete field documentation, including chain-of-custody records
- Incorrect decontamination procedures
- Incorrect collection of QC samples

Corrective action procedures will depend on the severity of the nonconformance. In cases where field personnel implement immediate and complete corrective action, the corrective action will be recorded in the field logbook and summarized in the daily field progress report.

Nonconformance issues that have a substantial impact on data quality require completion of a corrective action request form. An auditor or any individual who suspects that any aspect of data integrity is being affected by a field nonconformance may fill out this form. Each form is limited to a single nonconformance. If additional problems are identified, multiple forms will be used for documentation.

Copies of the corrective action request form will be distributed to the field team. If a nonconformance issue is identified, the field will meet to discuss appropriate steps to resolve the problem. Items to be discussed will include:

- Determine when and how the problem developed
- Assign responsibility for problem investigation and documentation
- Determine the corrective action to eliminate the problem
- Design a schedule for completing the corrective action
- Document and verify that the corrective action has eliminate the problem

The QA Manager can require data acquisition to be limited or discontinued until the corrective action is complete and the nonconformance is eliminated. The QA Manager can also request the reanalysis of any or all data acquired since the system was last in conformance.

6.4.2 Laboratory Procedures

Internal laboratory procedures for corrective action and a description of nonconformance situations requiring corrective action are contained in the laboratory QA Plan. At a minimum, corrective action will be implemented when any of the following three conditions occur:

- Control limits are exceeded
- Method QC requirements are not met
- Sample holding times are exceeded

Nonconformance situations will be reported to the QA Manager. In addition, a corrective action report signed by the laboratory's analyst, supervisor, and QA/QC manager or designee will be provided to the QA Manager.

7.0 References

Department of Defense (DoD) Environmental Data Quality Workgroup (EDQW), 2017. Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1. January.

United States Environmental Protection Agency (EPA), 2000a. *EPA Order - Policy and Program Requirements for the Mandatory Agency-Wide Quality System*. Classification No. 5360.1 A2.

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_____, 2017b. *Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review*, EPA-540-R-2017-002. January.

ATTACHEMENT A-2

CONTRACTOR & SUBCONTRACTOR QUALIFICATIONS

Geosyntec consultants

DAVID J. FOLKES, P.E.
Senior Principal

groundwater investigation & remediation
vapor intrusion evaluation & mitigation
soil investigation and cleanup

EDUCATION

M.A.Sc., Civil Engineering, University of Toronto, Canada, 1980
B.A.Sc., Geological Engineering (honors), University of Toronto, Canada, 1977

PROFESSIONAL REGISTRATIONS

Colorado Professional Engineer No. 23229

CAREER SUMMARY

Mr. Folkes has 40 years of experience in environmental and geotechnical consulting, with special expertise and experience in several areas including vapor intrusion, groundwater and soil investigation and remediation, and litigation support, as described below.

Mr. Folkes has also addressed soil and groundwater contamination at numerous sites across the country under RCRA, CERCLA, UST, Brownfields, Solid Waste, Voluntary Cleanup and other regulatory programs, including chlorinated solvents, 1,4-dioxane, metals, petroleum, nutrients, pesticides, PCBs and other compounds. He has investigation the nature and extent of soil, groundwater, and vapor impacts and complex mining, metals processing, industrial, and solid waste sites, including source identification and migration pathway and transport evaluations. Groundwater remedies evaluated and/or implemented under his management include in-situ bioremediation, in-situ chemical oxidation, soil vapor extraction, dual phase extraction, and other technologies. He has provided expert testimony in both state and federal court on groundwater issues.

Mr. Folkes has worked on numerous oil and gas sites, including operating and former oil refineries as gas plants, distribution and blending facilities, exploration and production fields, and retail sites. Over the past 17 years he has helped the Wyoming DEQ oversee the investigation and cleanup of six major oil refinery sites, including removal of piping and infrastructure, soil remediation, LNAPL recovery, groundwater remediation, and boundary containment systems to protect adjacent rivers.

Mr. Folkes is an expert in the evaluation and mitigation of vapor intrusion (VI). He has worked on over 175 VI projects across North America and overseas over the past 20 years, including sites in Europe, South America, Australia, and Southeast Asia. He has managed and directed work at one of the largest VI sites in the US and has served as an expert witness on several major VI cases, including class action lawsuits.

Mr. Folkes has also helped metals processing and mining companies address metals issues in all media including management of remedial investigations, feasibility studies, and remedial action for over two decades at the Asarco Globe Plant in Denver Colorado; forensic investigations of anomalous arsenic concentrations in surface soils; expert testimony on several class actions alleging soil contamination due to historic smelter and metals refinery emissions

Geosyntec consultants

REPRESENTATIVE PROJECTS

***Redfield Site**, Denver, CO.* Mr. Folkes is the Project Director for investigation and remediation of a two mile long chlorinated solvent plume, including evaluation of on-site and off-site remedial alternatives; design and installation of a groundwater hydraulic containment system, including cVOC and 1,4-dioxane treatment; characterization of three separate DNAPL source zones in weathered bedrock and alluvium; ISCO pilot testing; design and installation of in-situ anaerobic and aerobic bioremediation systems; forensic evaluation of the contributions of other sources, and expert and consulting witness roles in class action and insurance cost recovery lawsuits. The scope of work has included indoor air testing of over 700 buildings, design and installation of sub-slab depressurization systems in over 350 homes and apartments.

***PCE Plume Remediation,** Casper, WY.* Mr. Folkes is the Project Director for the investigation remediation of soil and groundwater associated with historic releases of PCE from a dry cleaner in Casper, WY, which resulted in a dissolved phase plume extending over one mile to the North Platte River. The work is being done for the Wyoming DEQ under the Orphan Sites program. An MiHPT probe was used to evaluate the nature and 3D extent of DNAPL source material in the aquifer and allow targeted injections of emulsified vegetable oil to stimulate anaerobic biodegradation in the source zone. In addition, an SVE system is being installed to remediate residual solvents in the vadose zone, which are contributing to elevated indoor air levels in adjacent buildings. The downgradient dissolved phase plume is being managed through MNA and institutional controls, with contingencies for more aggressive action if remediation milestones are not met.

***Technical Support, Oil Refinery & Gas Plant Cleanup,** Wyoming*. Mr. Folkes is assisting Wyoming Department of Environmental Quality (WDEQ) with oversight of investigations and cleanup of groundwater, LNAPL, sediments, and other media at several former and operating refineries and gas plants across Wyoming. Work typically includes review of investigation work plans and reports, remedy design documents, remedy implementation work plans, monitoring reports, and remedy completion reports; participation in collaborative work groups on various technical issues, and presentations to the public. Issues include NAPL recovery; groundwater containment; groundwater flushing and pump and treat remedies; air sparging, in situ biodegradation, MNA, and phytoremediation of groundwater; vapor intrusion evaluation and mitigation; sediment and soil cleanup.

***Former Chemical Manufacturing Facility,** East Rutherford, NJ.* Mr. Folkes is the Project Director for evaluation and remediation of a chlorinated solvent source zone in peat and estuarine sediments, including O&M of an ozone sparging system installed by others and evaluation of more cost-effective alternatives. Challenges include an immediately adjacent tank farm and building, a shallow water table and seasonal flooding, and truck traffic over the source area. The LSRP has agreed that the existing system designed by others can be shut off to evaluate the potential for MNA and/or more passive systems.

***Former Lead Smelter, Arsenic Refinery, & Cadmium Plant,** Denver, CO.* Mr. Folkes was the Project Manager of remedial investigations, feasibility studies, and remedy design and

implementation at a former smelter and metals refinery that operated from 1886 into the early 2000s. Responsibilities included direction of multi-media remedial investigations; multi-media feasibility studies and alternative evaluations; and selected remedy designs for groundwater, soil, surface water, sediment, and air emission issues. Supervised preparation of construction plans and specifications for groundwater interception drain, and implemented several interim remedial actions including pipe repairs, groundwater interception, and temporary capping of tailings material. Project completed in 2005 with some follow-on work for CDPHE.

Rocky Mountain Arsenal, *Colorado.* Mr. Folkes served as a consulting expert to the Colorado Department of Public Health and Environment (CDPHE) and the Colorado Attorney General's Office, assisting with technical evaluation of contamination and remediation of solvents, metals, and other compounds at the RMA. Services were provided under subcontract to the prime consultant to the state.

Evaluation of the Source of Arsenic in Community Soil, *Denver, Colorado.* Mr. Folkes was the Project Manager and principal investigator for the evaluation of the source of high arsenic and lead concentrations in community soil around a former arsenic trioxide refinery. Work conducted under his direction including geo-statistical modeling and analyses, scanning electron microscope analyses, and review of historic aerial photographs and building construction records. The work showed that stack and fugitive emissions from the historic arsenic refinery site were not responsible for the most of the high arsenic concentrations observed in off-site soils, particularly in distal communities. The source of high arsenic soil concentrations was application of arsenic and lead bearing herbicides and insecticides during the 1950's and 1960's. EPA and CDPHE ultimately agreed with these findings, issuing a ROD that identified pesticides as the source of the arsenic.

ACHIEVEMENTS

W.S. Wilson Award, first place standing in graduating class, University of Toronto, 1977.

National Research Council of Canada, "young engineer" selected to prepare 5th Canadian Geotechnical Colloquium, presented at the 34th Canadian Geotechnical Colloquium, Fredericton, New Brunswick, 1981.

Outstanding service award, Interstate Technology & Regulatory Council (ITRC) vapor intrusion team, 2005.

Geosyntec consultants

THOMAS J. KRASOVEC, P.E., REC

geotechnical & civil engineering & design
environmental assessment & remediation
project management & engineering
structural restoration & reinforcing
facility assessment & maintenance

EDUCATION

B.S., Geological Engineering, Colorado School of Mines, 1983

REGISTRATIONS AND CERTIFICATIONS

Professional Engineering Licenses - Michigan, Texas, Colorado, Florida and North Carolina

Registered Environmental Consultant in North Carolina. (No.00171)

CAREER SUMMARY

Mr. Krasovec has over 31 years of experience in geotechnical, environmental and civil engineering and consulting with expertise and experience in foundations, earth retention, impoundments, soil and groundwater investigations and remediation and structural restoration as described below.

Mr. Krasovec has completed numerous geotechnical assessments for foundations, earth retention systems, roadways, wind turbines, utilities, wastewater treatment plants and restoration/repairs to settling or heaving structures. He has been an expert witness in several cases regarding the settlement or heaving of commercial and residential structures. Mr. Krasovec has also successfully completed numerous engineering and environmental projects throughout the United States from initial investigation through feasibility, remediation and closure. These have included the assessment and cleanup of hazardous waste soil and groundwater contamination, design and construction of caps for onsite landfills to the cleanup and capping of a landfill on property purchased by the US Parks Service. Hazardous waste assessments and cleanups included, metals, volatile organic hydrocarbons, semi-volatile hydrocarbons, dioxanes, PCBs and pesticides in soils, groundwater, drums, or site equipment and structures. The projects were completed under RCRA, CERCLA, TSCA, and other state or federal programs. Managed the environmental department of an oil refinery to bring the facility and it's reporting into compliance with state and federal regulations under a EPA ROD. This included managing the proper containment of VOCs and dioxanes during a turn around and providing proper documented disposal. Completed remediation projects using dual phase extraction, insitu bioremediation, thermal absorption, vapor extraction

and sparging, ozone/oxidation systems, carbon absorption and general offsite disposal. Completed the assessment and cleanup of underground storage tank site, large residential sites used for commercial activities and site storm water ponds for trucking facilities bringing each site to closure. Designed oil-water separators for storm water systems. Conducted the assessment and design of secondary containment structures for above ground storage tanks and hazardous waste containment for commercial properties and oil refineries. Communication and negotiating abilities used to work through regulations to solve construction and environmental problems with integrity and accountability in a timely fashion.

Total Petroleum, *Alma, Michigan* Mr. Krasovec was the acting environmental manager for the refinery for over 6 months. He brought a team of 6 engineers and scientists in to assist in bring the facility in line with required reporting and monitoring. He also made recommended adjustments to the wastewater plant and several refinery units to help achieve compliance with air and water discharge permits. The project was to take control of all reporting, monitoring and environmental matters and interface with the EPA and the operations personnel. The site was under a consent order due to improper reporting, air discharges exceeding permit limits, wastewater discharges exceeding permit limits, improper storage and disposal of hazardous waste and many other issues. Mr. Krasovec brought all monitoring back in line with requirements including air, stormwater, wastewater, collection and storage of waste, disposal of waste and general record keeping. He also designed new hazardous storage areas constructed to meet regulations, the wastewater treatment plant adjusted to meet discharge requirements and all waste disposal to be properly characterized and sent to EPA approved licensed facilities. He designed a water treatment system for containment during a turnaround of the facility to treat VOCs and Dioxanes. A new contingency plan was drafted as well as an SPCC, SWPPP and SWMP for the site.

Large Industrial Facility, *Laurel Hill, Connecticut* Mr. Krasovec was the Senior Engineer and Project Manager for the site assessment, cleanup and closure of the facility and was the primary contact with the governing agency for the client. This project included monitoring wells in shallow and deep aquifers to delineate the extent of groundwater impacts with the deep wells extending into bedrock. Delineation of the extents of an onsite landfill, assessment of the landfill contents, design of a cap for the landfill and construction of the cap. The sampling and evaluation of floor drains, trenches, walls floors, on site equipment, silos, conveyor systems, etc. to identify areas of hazardous waste and other regulated wastes requiring remedial actions. Management of the demolition cleaning and disposal of mixing bins and the associated wash water. He managed and completed the cleanup and disposal activities for the hazardous wastes as well as all verification and reporting to bring the site to closure under the CTDEP Voluntary Remediation Program. Mr. Krasovec was able to save the client more than a million dollars on this project.

Former Lucy Road Landfill, *Howell, Michigan* Mr. Krasovec was the Senior Engineer and Project Manager for the assessment of soils, groundwater, methane gas generation and limits of the historic landfill that was not properly closed in the 1980's. the work included a complete hydrogeologic assessment, feasibility study and remediation. The project included a network of over 70 monitoring wells, fourteen methane gas probes, two passive methane gas vents, drum removal and interim and final remedial measures with long term monitoring. The site was brought to no further action with long term monitoring of the wetland area and methane gas as required by landfill regulations. Mr. Krasovec was able to bring this project to a no further action status after numerous firms had tried over the previous 30 years.

Large Industrial Facility, *Taftville, Connecticut* Mr. Krasovec was the Senior Engineer and Project Manager for the complete hydrogeological and contaminant assessment, feasibility study, remedial action plan and remediation of the site. The site soils and groundwater were impacted with volatile organic compounds and metals. This included Ground Penetrating Radar (GPR), Electromagnetic testing (EM), installation of monitoring wells, soils boring, design and installation of an air sparging/soil vapor extraction system, monitoring of the system, removal and disposal of metal impacted soils, negotiations with regulators and final closure of the site. The site was one of the first brown field redevelopments in Connecticut. The completed project saved the client several million dollars.

Vapor Intrusion

Commercial Site, *Woodland, New Jersey* The project included the assessment of soil and groundwater conditions for the potential redevelopment of the site with commercial structures. The site was previously a repair shop and/or gas station. These sites contained soils and shallow groundwater impacted above cleanup criteria and specifically exceeding volatilization criteria. The mass exceedances of direct contact criteria in soil were removed prior to redevelopment. Mr. Krasovec completed the assessments, reporting and designed a vapor mitigation system for the new structure. The vapor mitigation systems assured that employees and the public would not be exposed to hazardous vapors from the underlying soil and groundwater.

AWARDS AND RECOGNITIONS

Excellence in Engineering - American Society of Civil Engineers (ASCE) 1995, for the Spartan Stadium Renovation Project

TEACHING EXPERIENCE

Michigan State University, Single Class on Dam Failures, 1994, Geotechnical Engineering

ACTenviro Related Project References

Naval Auxiliary Landing Field San Clemente Island Installation Restoration (IR) Program Site 1, Lemon Tank Canyon Disposal Area PCB Removal Action - Naval Facilities Engineering Command Southwest (NAVFAC SW), Tinina Guzman Remedial Project Manager (RPM)

This project involved clearance for Unexploded Ordinance and the removal and disposal of 2,400 cubic yards of PCB and metal impacted soil at the former disposal site. Upon completion the site was restored with native vegetation. This project was conducted on an island off of Southern California that is active range for the US Navy. This project required close coordination with the installation staff.

Marine Corps Air Station Miramar IR Site 1 Removal Action - NAVFAC SW, Rick Raines RPM

This Non-Time Critical Removal Action involved the removal and disposal of 4,300 cubic yards of Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, and PCB impacted soil for the site. Upon completion the site was restored with native vegetation. This project was conducted in area of sensitive habitat and vernal pools. All of the sensitive habitat were protected during the removal action.

Naval Air Station North Island Fuel Facility UST and Piping Closures - NAVFAC SW, Tinina Guzman RPM

This project involved the in-place closure of four 610,000 gallon concrete USTs, one 49,000 gallon steel UST, one 40,000 gallon steel UST, and five miles of underground fuel piping. Due to shallow groundwater at this coastal site, the USTs were isolated and filled with a low density foam and concrete mixture from and on-site batch plant. The piping was pigged, isolated, filled with nitrogen, and capped. The project involved close coordination with base personnel as some of the piping crossed active runways and taxiways.

Marine Corps Reserve Center San Diego AST Removal - NAVFAC SW, Marilyn Vasquez RPM

This project involved the cleaning and removal of one out of service concrete and steel (concrete liner with inner steel shell) 7,500 gallon AST for recycling. The AST was pressure washed and removed using crane to move it on to a transport truck for transportation to the recycling facility.

Marine Corps Air Station Yuma AV-8 Harrier Mishap Site Removal Action at the Gila River Indian Reservation - NAVFAC SW, Adam Hill, RPM

This project involved the removal and disposal of 130 tons of jet fuel impacted soil that resulted from a mishap of a US Marine Corps AV-8 Harrier on undeveloped desert land on the Gila River Indian Reservation in Arizona. Confirmation samples were collected and analyzed to confirm all of the impacted soil had been removed prior to backfill of the excavation. This project required close coordination with Reservation Staff due to the proximity of sensitive Native American artifacts in the area.

C. JACOB BLANTON
PROJECT MANAGER – REMEDIATION SERVICES

EDUCATION: CAD Design Technology / Ivy Tech State College, Indiana

TRAINING:
40-Hour HAZWOPER
10-Hour Construction Safety
Excavation Competent Person
Competent Rigging Certification
MSHA Mine Safety
Certified Equipment Operator
Universal Waste Handling/Emergency Response
Low/High Voltage Electrical Safety
Stormwater Training
Power Safe Training
DOT Highway/Interstate Construction Safety
Confined Space Training
TWIC Certification
First Aid/CPR Training

QUALIFICATIONS:

Mr. Blanton has over 17 years of experience in construction and environmental project management. His experience includes environmental remediation, groundwater treatment systems, bidding, estimating, hazardous materials abatement, project supervision, utility construction, building construction, general contracting, and emergency response management.

As project manager, Mr. Blanton has overseen the removal of MGP impacted soils, various remedial projects, hazardous materials abatement, water treatment operations, demolition, and many other environmental projects. Mr. Blanton has extensive experience in the installation of groundwater treatment systems. He also has experience in managing and coordinating subcontractors in many different areas of specialty. In general, Mr. Blanton has managed many complex remediation projects which have given him the background and experience to be an efficient and productive project manager.

In addition to his environmental remediation experience, Mr. Blanton also owned and operated a small building construction business, some of his experience includes new and existing home design, project management, general contracting, marketing, bidding, estimating, and subcontractor management, among many other activities.

SPECIFIC PROJECT EXPERIENCE

- **Local Gas Utility Company, Pipeline Decommissioning.** As project manager, Mr. Blanton manages the abandonment of old gas pipelines. Included with abandonment is the proper remediation of PCB-impacted materials and other hazardous materials. Successfully abandoned and remediated thousands of feet of pipeline in the St Louis metro area.

- **Confidential Client, Chemical Refining Company.** As project manager, Mr. Blanton developed a complete work plan and air monitoring plan to remediate soils impacted with Debutanized Aromatic Condensate (DAC). The client contracted with PSC to surgically remove contaminated soils that lay directly underneath a rack of 10 active gas pipelines. The pipelines were so close together it was impossible to use conventional excavation equipment and the client could not take the pipelines out of service. He developed a comprehensive plan to constructed platforms above the pipelines for crews to work from and used hydro-excavation methods to excavate material up to 5' below active pipelines while never taking the pipelines out of service and safely removing impacted soils. To facilitate the excavation work, an active asphalt roadway had to be removed and replaced upon completion. Upon excavation completion, the roadway was re-constructed to exact client specifications, the excavation was backfilled and compacted to meet client specifications.

- **Confidential Client, Newark, New Jersey.** As project manager, Mr. Blanton managed the remediation of diesel and lead contaminated soils. Project included soil excavation in an extremely tight area between a diesel storage tank and its 30-foot-tall containment walls. Access and egress to the remediation area was restricted to one 10-foot-wide opening in the containment walls. Involved the safe removal of non-hazardous and hazardous soils and groundwater.

  Mr. Blanton solicited this opportunity; completed a comprehensive proposal and work plan; managed and coordinated all field activities; managed and coordinated all soil disposal; and completed this project on schedule and within budget.

- **Shell, Kankakee, Illinois.** As construction manager, Mr. Blanton managed a multi-million dollar cleanup project that included the construction and installation of 12-inch stainless steel recovery wells, installation / maintenance of a 500 GPM water treatment system, all mechanical piping installation and testing, decommissioning of 3 collection trenches, installation of a product collection trench 30" wide and 20' deep, of which 8' is into bedrock, the installation of HDPE compressed air / discharge piping, the installation of a 2-acre HDPE lined holding basin, the construction of a wood framed pump house building with a 24 hour pumping system, site grading and restoration of a 14-acre site, and installation of an Akwadrain system. In addition, Mr. Blanton also managed site air monitoring operations.

- **Former MGP site, Champaign, Illinois.** As construction manager, Mr. Blanton provided management for all site activities to complete a multi-million dollar MGP waste removal project. Major tasks included removal of impacted soils / debris, onsite LGAC treatment and discharge of two million gallons of wastewater, and setup and takedown of a temporary sprung structure. The primary constituents of concern were benzene, toluene, ethylbenzene, xylenes (BTEX), polynuclear aromatic hydrocarbons (PAHs), cyanide, and RCRA metals. Approximately 187,000 tons of MGP-impacted soil were excavated, transported, and disposed. The excavation depths ranged on average from 20 to 25 feet below ground surface. The soil excavation was completed within a temporary tent structure, approximately 40 meters by 65 meters in size, to minimize dust and odors in the surrounding area. Due to the size of the property, the remediation was completed in nine individual phases and the tent structure was relocated for each phase. The excavation was backfilled with non-impacted soil or CA-6 and compacted to 95% standard compaction. The site perimeter areas that could not be excavated beneath the tent structure were removed to a depth of 3 to 10 feet below ground surface as an open-air excavation following the nine remedial phases. In addition, Mr. Blanton worked with the public, the local media, and environmental groups to ensure safety and serve as the site contact.

- **Union Pacific Railroad, Chadron, Nebraska.** As construction manager, Mr. Blanton managed crews to perform remedial activities including removal of diesel fuel / motor oil contaminated soils, decommissioning product recovery systems, demolition of buildings / AST concrete footings, the removal of railroad ties, and the treatment/discharge of 30,000 gallons of wastewater. Excavation activities extended to depths of 17 feet BGS. In addition, Mr. Blanton also performed the surveying, designed a field layout, and constructed a new compacted railroad base. He also worked closely with Union Pacific consultants in order to meet their goals and specifications. Mr. Blanton completed this project on schedule and below project budget.

- **Former MGP Site, Decatur, Illinois.** As construction manager, Mr. Blanton provided management for all site activities for the removal of MGP impacted soils. He also managed and coordinated subcontractors for fencing, sheet-piling and tie-backs, electrical, and backfill. He also managed the installation, operation, and maintenance of an onsite LGAC treatment system. Managed excavation depths up to 22 feet BGS while using slide-rail shoring. Multi-phased remediation project that included the movement of a temporary fabric structure (TFS) and interior (carbon) adsorption air filtration systems.

- **Confidential Client, Alabama, Mercaptan Remediation.** As construction manager, managed all field activities to successfully remove and dispose of mercaptan impacted soils due to a vessel release. Involved extensive hand excavation work around active natural gas equipment and pipelines. Odor suppression and a temporary fabric structure was used to minimize odors and eliminate exposure to public. Managed all air monitoring activities and managed according to ADEM standards. Completed on schedule and on budget.

- **Various Emergency Spill Response Projects in Illinois and Missouri.** As project manager, Mr. Blanton has provided site supervision to remediate PCB and non-PCB mineral oil impacted soils, gravel, and structures.

- **Peru Huntsman Substation.** As project manager, Mr. Blanton managed the removal of heavy metals impacted soils. Utilized soft digging technology to remove soils and contain in vacuum boxes for disposal

- **Pinckneyville Power Plant, Spill Response.** As construction manager, Mr. Blanton oversaw all site activities including removal of turbine oil impacted gravel and soils using air excavation methods. He also provided field design and managed the installation of 3 twelve-inch oil recovery (extraction) wells to assist with oil recovery below groundwater. Mr. Blanton also supervised the cleaning of electrical vaults for the removal of turbine oil.

- **Bell Atlantic / Former MGP site, Bradenton, Florida.** As construction manager, Mr. Blanton oversaw the removal / disposal of cyanide and arsenic impacted soils. In addition, various concrete footings demolition, coal tar removal, and site reconstruction was performed. This project was completed on schedule and below project budget.

- **Ameren IP, Marissa, Illinois.** As project supervisor, Mr. Blanton oversaw substation demolition activities including concrete footings, a steel-framed building, and various concrete objects. In addition, he also supervised the removal of mineral oil contaminated soils.

- **Industrial Building Pre-Demolition, Kansas City, MO.** As construction manager, Mr. Blanton managed pre-demolition activities to remove and dispose of various hazardous materials. Oversaw the removal of PCB ballasts, florescent bulbs, mercury containing thermostats, waste oils, etc.

- **Chemtura, Painesville, Ohio.** Equipment operator / lead supervisor at the Chemtura project site. Placed a low permeability layer consisting of a 3-foot (0.91 meter) minimum thickness clay layer, compacted to achieve a 95% Standard Proctor and permeability of 1x10-7 centimeters/second, or

less. Work involved grading and placing a soil cap over an existing landfill and reconstructing and grading of an existing Lagoon berm. Landfill capping & closure activities also included constructing a final protective layer at an adjacent 4.4 acre cell with a 4-inch topsoil placement. The final protective layer was placed over the low permeability layer to prevent desiccation, cracking, freezing, or other damage.

- **Burlington Northern Railroad, Clarksville, Missouri.** Lead Operator at a railroad bank stabilization project. Site activities included placing large Rip Rap to extend the banks of the Missouri River out approximately 80 feet to stabilize a railroad base.

- **Ameren Taum Sauk Power Generating Facility, Southeastern Missouri.** As project supervisor, Mr. Blanton managed a crew of union personnel to perform the hazardous materials removal / disposal and miscellaneous debris.

- **Ameren UE, Page Ave, St. Louis, Missouri.** Lead equipment operator at the Ameren UE Page Avenue site. Work involved the excavation / loading of PCB contaminated soils at a turn of the century Power House. Work also included backfilling / compacting operations, breaking up concrete footings/structures, and removal of large concrete vaults.

- **Union Pacific Railroad, Chicago, Illinois.** Lead equipment operator at two UPRR sites. Work involved the excavation / removal of three underground storage tanks.

- **Ameren IP, Eden, Illinois.** Lead Operator at this active natural gas storage area. Work involved the excavation / loading of impacted soils and backfilling operations.

- **LUST / PCB site, Galesburg, Illinois.** Lead equipment operator at the Galesburg site. Work involved the excavation of impacted soils and PCB impacted soils and all backfilling operations.

- **Former MGP site, Huntsville, Missouri.** Lead equipment operator for the project. A total of 4,455.52 tons of MGP impacted soils exceeding applicable MRBCA levels were transported offsite and disposed of locally as a “contaminated soil” at a Subtitle D Landfill. Approximately 85,500 gallons of remediation-derived water were treated onsite and disposed at the Huntsville Wastewater Treatment Facility. Site restoration activities included returning the grade to previous elevations with some drainage modifications, installation of drain to prevent erosion across the site, creek bank stabilization, seeding, and partial street replacement.

CONSULTING, DECONTAMINATION & DECOMMISSIONING, AND REMEDIATION SERVICES AT A FORMER BULK FUEL FACILITY

PSC was contracted to perform turnkey consulting, decontamination & decommissioning (D&D), and remediation services at a former bulk fuel terminal. The site encompassed approximately 10 acres and consisted of seven aboveground bulk storage tanks (ASTs), underground product lines, a truck loading area, and an office building. The facility formerly stored leaded and unleaded gasoline, diesel fuel, jet fuel, and ethylene glycol anti-icing additive.

PSC developed work plans, and provided estimates and contracting for the following D&D activities:

- removal of seven petroleum ASTs, three smaller tanks, and a hydrocarbon processor
- removal of a metal canopy, piping/meters at the truck rack, a modular metal building and associated piping, underground piping from tanks within battery limits, fire protection lines and capping at main, and subsurface electrical conduit within battery limits
- scrapping of a shed, generator, electrical panels; the rectifier and three transformers; barge, barge platform, and associated piping; and the pump house and railroad tracks
- cutting, grouting, and scrapping of pipelines

The following environmental services were provided by PSC during the D&D effort:

- lead paint sampling and implementation of a lead awareness program
- abatement and disposal of asbestos from sheds, the generator building, and asbestos-containing underground pipe wrap
- disposal of a polychlorinated biphenyl (PCB) transformer and capacitors and of non-PCB-containing dielectric fluid
- analysis (for TCLP BTEX) and proper disposal of activated carbon from a vapor recovery unit
- disposal of the contents of an underground storage tank (UST) discovered during the D&D activities
- clean up of residual free product in piping (pumped into drums and recycled)

Consulting and remediation services provided included the following:

- Site Remediation Plan, temporary treatment system construction/operating permits, construction/demolition permits, construction stormwater pollution prevention plan, final grading plans, building asbestos survey, construction oversight
- Remediation of over 46,000 tons of petroleum-impacted special waste
- Utility relocates and building demolition
- In-situ bioremediation of petroleum-impacted groundwater (oxygen release compound application and high vacuum extraction)
- Closeout documentation including disposition of all residual material

Following completion of site activities, the Missouri Department of Natural Resources issued a "*no further action*" letter for the site.

CLIENT:

Confidential Refining Company

LOCATION:

St. Louis, Missouri

PROJECT VALUE:

$2,000,000
(+ value of recovered scrap)

SERVICES PROVIDED:

Removal & Scrapping of Various Buildings, Tanks, and Piping

Asbestos Abatement

Plans/Permitting

Sampling and Analysis

Construction Oversight

Investment Recovery

Soil Remediation

Groundwater Remediation
Closeout Documentation

SELECTED PSC REMEDIATION PROJECT EXPERIENCE

Site Location	Activities Performed	Client
Cyril, OK *Oklahoma Refining Co. Superfund Site*	PSC completed all work on a Superfund Site Remedial Action at the site of an abandoned refining facility. The work involved **remediation of impacted soils and sludges** contained in over 20 surface impoundments that had been utilized for decanting and disposal of various waste streams associated with refinery operations. Contract value was $11,600,000. Project activities included: • Constructed a 4.5 acre Non-Hazardous Waste landfill per RCRA Subtitle D standards. Elements included a base layer of impermeable clay, 60 mil HDPE liner, sand drainage layer, geotextile, buffer soil, 40,000 cubic yards (cy) of impacted soil, construction fill, 40 mil HDPE liner, sand drainage layer, geotextile and 2-foot topsoil layer. • Constructed a 7-acre Hazardous Waste Landfill per RCRA Subtitle C standards. Elements included a 3-foot layer of recompacted subgrade, two 60-mil HDPE liners forming primary and secondary layers encapsulating a geo-composite leachate detection system, sand drainage layer, buffer soil, 59,000 cy of impacted soil, construction fill, 40 mil HDPE liner, sand drainage layer, geotextile, and 2-foot topsoil layer. Other elements of the project included: • abandonment of 5,000 feet of production and monitoring wells • construction and operation of temporary water treatment system • access/haul road construction • installation of 9,700 feet of security fence • ex-situ biotreatment of 70,638 cy of hydrocarbon impacted soil • in-situ biotreatment of 22,878 cy of soil impacted with heavy hydrocarbons • stabilization of 13,611 cy of metals impacted soils • neutralization of 18,471 cy of buried acid material • excavation, transportation and offsite disposal of 34,000 cy of asphaltic material • demolition of five above ground storage tanks • regrading and revegetation of 120 acres Acid neutralization work was performed in Level B personal protective equipment due to high levels of poisonous gasses produced during the reaction of the waste material with reagents. Impacted soil/sludge excavation, soil biotreatment, and soil stabilization was performed in Level C. Extensive air monitoring for site contaminants was performed to assess air-borne concentrations at site boundaries and work areas. Continuous monitoring using real-time instruments was conducted for total suspended particulates. The QA/QC team was responsible for data gathering, collection, verification and implementation of Corrective Actions for non-conformance issues and provided analytical sampling and data interpretation to assure that Remedial Action Objectives (RAO's) were met.	***Oklahoma Department of Central Services***
Longview, TX *former wood treating facility*	PSC served as remediation contractor for this extremely high profile project involving the **removal of impacted soil** adjacent to and under BNSF mainline railroad track. Excavation involved 30,000 tons of impacted soils and debris. Wastewater treatment totaled 369,000 gallons. The project was on a tight schedule to allow landfill disposal before changing restrictions excluded this waste. Soil remediation was complicated by the presence of an operating mainline railroad track. The PSC crew displayed its versatility as the project scope evolved to include removal and replacement of mainline tracks, construction and operation of a wastewater treatment system for remediation of storm water and groundwater. Additionally, PSC constructed storm water drainage channels at the site.	***Burlington Northern Santa Fe Railroad***

Site Location	Activities Performed	Client
Houston, TX *Galena Park Terminals*	PSC provided **site characterization, TPH soil bioremediation, and lead stabilization** services. Over 10,000 cy of lead impacted soil were stabilized and over two thousand cubic yards of TPH impacted soil were bio-treated. PSC conducted remediation operations successfully in a period of less than three months. Project value exceeded $ 350,000.	***Kinder Morgan Liquids Terminals, LLC***
Buffalo, NY *Scajaquada Creek*	PSC **remediated a public waterway contaminated from previous coal gas operation**. Work was performed under a consent decree issued by NYDEC. 1,600 linear feet of creek bottom were surgically excavated at defined depths. PSC constructed temporary water dams at each end of the creek bed to prevent water intrusion during work. The creek was pumped dry and pumping/water control systems were put in place to control rain or surge event. A decontamination station and drying bed was also constructed. Using marsh buggy excavators and shore operated long stick excavators, the contaminated materials were removed, hauled to drying areas, analyzed, loaded and hauled to off-site disposal facility. Work was accomplished in and around a railroad bridge and several new overpass bridge piers. During construction, all water was tested and treated prior to disposal at the local POTW. Following excavation, a new creek bottom was constructed with a layer of GCL, followed by 18" of sand and 6" of armorstone. All disturbed areas were restored to original conditions.	***National Fuel Gas***
Pickens, SC *former landfill*	PSC was contracted to **clean-close a former landfill containing PCB-impacted soil** and debris generated by a former electrical capacitor manufacturing facility. A haul road was constructed to move the waste material from the remote landfill location to a staging area where material was loaded into trucks for transport to a TSCA landfill in Alabama. As excavation of the landfill began, unexpected waste was encountered. A total of 200 tons of intact electrical capacitors containing PCB dielectric fluid were segregated, cleaned, and loaded into roll-off boxes for incineration. PSC loaded out over 23,000 tons of impacted soil and debris within a 2-month period. A nearby hill was cut down to fill the excavation and the areas were graded and restored to park-like condition at project completion.	***RMT, Inc.***
Flagstaff, AZ *former Flagstaff Trap & Skeet Club at Koch Field*	PSC **removed and remediated lead-impacted soil** in a 65-acre area at a former shooting range. Other agents of concern at the site included arsenic and antimony. Systems were designed and implement to ensure dust control to avoid further lead contamination. Remediation activities included excavation of shallow contaminated site soils and contaminated soils in existing utility trenches; separation/screening of lead-contaminated soils from PAH-contaminated soils and of lead contaminated soils to remove lead shot; and solidification/Stabilization of contaminated soils where screening was insufficient. Treated and untreated soils were transported and disposed of at the Cinder Lake Landfill. Excavations greater than 8 inches were filled and regraded using existing site borrowed material.	***City of Flagstaff***
Grand Forks, ND *former landfill*	Project field activities for this **landfill closure project** included clearing and grubbing of existing vegetation, clean closure of designated areas, general grading, and installation of a 1,601,000 square feet flexible membrane liner underneath a 18-inch clay cap. A passive landfill gas vent system was also installed. Approximately 300,000 cy of soil was imported, placed, and compacted in the former landfill during the project. Work also included the abandonment of three existing monitoring wells and the installation of three replacement monitoring wells. These wells will be monitored as part of the post-RCRA closure activities. ***PSC was awarded a "Contractor of the Year" commendation for the work performed at Grand Forks.***	***U.S. Army Corp. of Engineers***
Watertown, NY	Remediation at this site included **decontamination and demolition of structures**; excavation and disposal of 200 tons TSCA, 350 tons RCRA and 2000 tons non-hazardous materials; excavation and regrading 15,000 cy of river bank; placement of erosion control; final grading; topsoil placement; and restoration.	***Abe Copper Surplus***

Site Location	Activities Performed	Client
Baytown, TX *Baytown Refinery*	PSC was the lead contractor in the most ambitious **demolition/abatement project** undertaken by the Baytown Refinery, performing a plant-wide unit survey and managing a continuing service contract worth over $1,000,000. Activities involved asbestos abatement and demolition of an entire pipestill unit. The pipestill #4 unit was surveyed and all material was identified and removed in conjunction with the overall demolition schedule.	***Exxon Company USA***
San Antonio, TX *golf course on Kelly AFB*	PSC performed **excavation, characterization, repackaging and disposal of buried radiological waste materials** that were stored in sealed reinforced concrete pipes buried below an area of a golf course. PSC performed surgical excavation to remove the waste containers intact, then transferred the containers to a temporary building for removal, characterization, and re-packaging of the contents. Impacted soil and water from the excavation was also characterized and disposed. The work area was backfilled and restored at project completion.	***Parsons Engineering***
Hearne, TX	PSC was retained by GATX to perform **solidification/stabilization of oily pond sludge** using quicklime reagent. The project included transportation and disposal of 380,000 gallons of pond water; excavation, loading, transportation, and disposal of solidified sludge and impacted soil; demolition of a 350 feet by 12 foot high retaining wall adjacent to a railroad spur; and backfilling/regrading of the former pond area. A total of 1,270 tons of quicklime was used to yield 14,000 tons of solidified sludge for disposal. An additional 4,500 tons of impacted soil was also excavated and disposed. All impacted materials were loaded out and disposed in a three-week time period through the coordinated efforts of PSC and its transportation and disposal contractors.	***GATX***
Crane, TX	PSC was contracted to implement BP's **EPA compliance program** involving PCB decontamination of plant compressed air systems (CAS) using PSC's EPA/ TSCA permit, PCB soil remediation, surface decontamination, CAS vessel demolition and associated regulatory compliance. The project included CAS vessel removals and upgrades, air system testing, site characterization, and associated remediation services. PSC decontaminated over 40,000 linear feet of air system piping and associated components, and excavated, transported, and disposed over 550 tons of PCB-impacted soil and debris. The contact value was over $ 1,000,000; the project was completed in four months.	***BP***
Pickens, SC	PSC **constructed a fully operational groundwater extraction and treatment system** to treat groundwater pumped from wells at several remote locations to a central treatment plant. Over 2 miles of conveyance piping was laid to carry the groundwater to the treatment plant. One mile of access road was constructed to provide access to the remote pumping locations. Two pre-engineered buildings were constructed to house water treatment and soil vapor extraction equipment. A soil vapor extraction system was constructed with 14 wells piped to an 1100 CFM Soil Vapor Extraction unit. An existing water treatment plant used to treat quench water from previous soil incineration operations was modified and expanded to treat the groundwater on-site. The project was completed in five months.	***RMT Sangamo Weston***
Houston, TX	PSC performed provided **asbestos decontamination, interior demolition**, removal of fireproofing, re-installation of several floors, lobby, and concourse levels on a emergency response basis. This project was worth over $1 million.	***Allen Center Company & Law Engineering***
Milan, TN *drum burial site*	PSC was contracted by Cape Fear Environmental (CFE) for **source removal work** at a drum burial site. CFE was the consultant representing a PRP group paying for the clean up work. The leaking drums buried in six pits had impacted aquifers down gradient of the site. Work involved excavation, removal and over packing of intact drums containing solvents, paint, sludge, and various other waste products. Deteriorated drums that could not be salvaged were mixed with kiln dust and surrounding impacted soils to form a homogenous solid waste suitable for disposal at a RCRA Subtitle D landfill. The excavation and solidification work was performed in Level B protection. 1,800 tons of non-haz material was disposed offsite.	***Cape Fear Environmental***

Site Location	Activities Performed	Client
Armagh, PA *natural gas compressor station*	PSC **remediated over 40,000 cubic yards of PCB-impacted soil**. Work involved hand and machine excavation, site restoration, and tree clearing from rugged terrain. Approximately 200 linear feet of asbestos-wrapped pipe was abated. PSC provided management personnel to oversee work performed by approximately twenty union personnel. The site covered 30 acres and contained multiple underground utilities to excavate around. Due to inclement weather conditions, PSC installed a carbon-based water treatment system to process approx. 1,500,000 gallons.	***Duke Energy***
Houston, TX *dry cleaning facility*	PSC utilized its Clean Soil technology to **treat 400 tons of soil contaminated with PCE**. The impacted soil was excavated to a depth of 32 feet at a location adjacent to a shopping center. The excavated soil was staged and treated in the Clean Soil Unit. The closed loop treatment process enabled PSC to secure the necessary air permits to treat soil adjacent to commercial and residential properties. All impacted soil was treated to levels low enough to allow for disposal at a RCRA subtitle C landfill. The remediation area was restored with structural fill and new concrete pavement.	***Pond Robinson & Associates***
Spartanburg, SC *former wood treating facility*	PSC **constructed a groundwater treatment plant** for the treatment of creosote-impacted groundwater. PSC was general contractor for the project with four subcontractors handling building construction, electrical, instrumentation, plumbing, and HVAC. Components of the treatment plant include three bioreactor vessels using a patented media and air to digest creosote contaminants. The treatment system, housed in a 30' by 75' enclosed metal building, is designed to treat up to 50 gallons of groundwater per minute with controls allowing it to operate unattended 24 hours a day. The vessels and tanks for the system were contracted separately by REMI with all other components provided by PSC.	***REMI Environmental***
Leeds, AL	For a voluntary cleanup program with the approval and oversight of the Alabama Department of Environmental Management (ADEM), PSC performed **in situ stabilization of lead-contaminated soi**l. Lead levels were in excess of 200,000 ppm. The area being treated was the load-out area where numerous tractor-trailers traveled daily. PSC constructed a temporary load-out area to reroute these operations during remediation activities. PSC used 10% by volume Portland cement and 2% triple super phosphate for stabilization. After treatment, the 3,558 cy of affected soil contained less than 1 ppm TCLP.After stabilization, the area was leveled and eight inches of ¾" crushed run road base was laid and the area was capped with 12,500 square feet of concrete eight inches thick. A new road of three-inch asphalt base was constructed and 1 ½" tack coat was applied. The new load out area was encapsulated with a keystone-segmented retaining wall. This was over 210 feet long and averaged 10 feet high.	***Acme Packaging***
Albuquerque, NM *former wood treating facility*	BNSF selected PSC as its remediation contractor for this high profile project involving **solidification and removal of impacted soil from a lagoon**. 6,000 tons of impacted soils and debris were excavated. Sludge and free liquids were solidified with on-site material. All excavated material was loaded onto rail cars for transportation to a hazardous waste landfill. The project was on a tight schedule to allow landfill disposal before restrictions excluded this waste from the landfill.	***Burlington Northern Santa Fe Railroad***
Charleston, SC *former MGP site*	Fluor/GTI selected PSC as its remediation subcontractor for this high profile project involving **removal of impacted soil from an MGP site**, located in the footprint of a proposed parking garage. Soil remediation was complicated by the presence of shallow groundwater at a depth of 18" below ground surface. The project scope evolved to include utility construction, seep mitigation into Charleston Harbor, on-site bioremediation, and construction of various systems utilized for remediation of soil and groundwater. PSC worked closely with Fluor and SCE&G to ensure the project was completed close to schedule, in spite of many changes to the scope of work. PSC was retained to continue source removal work in sensitive areas of the site including the electrical substation.	***Fluor Daniel/GTI*** *consultant for* ***South Carolina Electric & Gas***

Site Location	Activities Performed	Client
Phalba, TX *JCS Co. State Superfund site located near Phalba in Van Zandt County, Texas*	PSC performed **remediation activities** at this state Superfund site which had previously been used for automotive battery reclamation operations. The remedial actions consisted of the excavation and consolidation of materials from these affected areas and the subsequent capping of this material in a designated consolidation area. 5,464 cy of soil were excavated. All contaminated water was stored in lined temporary aboveground storage tanks and used for dust suppression on contaminated debris and soils. Excess contaminated water was treated on-site with a carbon filtration system and discharged to prevent pooling. The process building was demolished using heavy equipment, then divided into manageable pieces and transported to the waste consolidation area. Concrete was broken up and transported to the consolidation area. All building debris and concrete was evenly distributed across the bottom of the cap area prior to placing contaminated soil material. Drums were transported to the consolidation area and crushed flat. Battery debris was either placed in the bottom of the de-watered pond, spread evenly on the bottom of the cap area, or mixed with the contaminated excavated soil. All excavated areas were backfilled.	***Texas Natural Resources Conservation Commission (TNRCC)***
Saltville, VA *Saltville Power Plant*	At the, PSC performed a $1,000,000+ **dismantling and decommissioning** project at an old boiler plant and water treatment area. The plant was located on a potential Superfund site and representatives from the EPA inspected the progress of the project via a consent decree. Decommissioning activities involved **asbestos and lead abatement** of six boilers, associated pipe, and equipment insulation. The demolition started with the removal of transite panels from the exterior walls and roof and included the dismantling of the boilers, all equipment, and the structural steel within the building. Approximately 4500 tons of steel scrap was generated from the project operations.	***Olin Chemical Corporation***
Wichita Falls, TX *Estes Corp. facility*	Three PSC locations **responded to an herbicide spill** within hours of the initial call. The spill occurred when a BASF transporter overflowed storage tanks at the Estes facility. Additional problems were created when the storage tank shutoff valve was not properly closed prior to disconnecting the truck from the tanks resulting in a second spill outside the warehouse. Contaminants of concern were 2,4-D (Dichlorophenoxyacetic acid) and Dicamba. Prior to mobilizing equipment and personnel, PSC reviewed the information provided and prepared a Work Plan and site specific Health and Safety Plan for the PSC workers and supervising plant personnel. The operation was completed by the following evening. Restoration and final disposal were completed by the end of the following week. PSC also provided transportation and disposal coordination. PSC's decontamination and response process involved the use of specially formulated surfactants to clean the impacted concrete and minimize additional disposal volumes. Due to PSC's careful planning and unique approach, daily operations at the Estes facility were not impacted by the cleanup activities and both clients realized cost and time savings.	***BASF / Estes Corp.***
Bedford Heights, OH	PSC performed **PCB decontamination** of 40,000 square feet of concrete surface, 3,900 linear feet and 5,900 square feet of metallic surfaces, 1,805 linear feet of trenches and pits; remove and replace 2,900 square feet of wood block flooring; and manage and dispose the PCB waste generated during the remediation.	***ITT Automotive***
Watkinsville, GA	PSC removed three 10,000 gallon USTs used to store diesel fuel at an active wire cable manufacturing facility. All work areas were adjacent to or within the facility. PSC cleaned and scrapped the USTs, backfilled the location and installed a new 10,000 gallon aboveground storage tank (AST) in the same location. Stained soils in a drum storage area were excavated and disposed; the area was then restored with gravel. Hydraulic lift repair work inside the facility was subcontracted and PSC assisted the subcontractor by excavating impacted soil to provide access to underground piping. PSC was able to complete its work with no impact to plant operations.	***General Cable***

UNION PACIFIC ACETYLENE SLUDGE CLEAN-UP

Under a consent order between Union Pacific and the USEPA, PSC was contracted to clean-up two pits where waste sludge from the productions of Acetylene gas has been dumped in the 1940's. The first pit (Pit A) was approximately 150' x 120', and the second pit (Pit B) was roughly trapezoidal in shape with overall dimensions of about 90' x 75'. At some point after the sludge was placed into the pits, solvents were introduced through dumping or spilling. As a result, samples showed hazardous levels of Tetrachloroethene in the ponds and in underlying soils.

The client initially requested that all sludges and a 1' thick layer of underlying soils be removed and sent for incineration as F001 wastes. PSC determined that a more appropriate waste code was D039 (characteristic for Tetrachloroethene) since Tetrachloroethene was not used during the production of Acetylene gas. PSC also suggested that the two pits be gridded into 13 sections and sampled to determine areas of differing types of wastes so that costs could be saved in disposal. As a result of our sampling plan, 1,640 tons of the materials were deemed as non-haz, 800 tons were considered hazardous soils that could be landfilled, and only 3,800 tons of the total 6,300 tons anticipated, required incineration. The additional $50,000 in sampling costs saved the client approximately $750,000 in disposal costs.

PSC mobilized to the site to conduct the characterization sampling. The samples were analyzed by the client's laboratory and the results were received in about six weeks. Hazardous wastes were excavated with a track loader and placed into the bucket of a large (6.5 yard) rubber tire loader which then transported the waste to railcars (supplied by UP) on an adjacent siding. All gondola loading work was performed after rail operations in the yard ceased for the day. Much of the loading was conducted at night with the use of light towers with typical production of 8 cars per 12 hour shift. PSC used 40 x 100 sheets of 6-mil visqueen to line the cars. Rain and wind hampered production at times, making it difficult to line the gondola cars with the visqueen. The extra width was used for flopping over the top as a cover; this flap was weighted down with sandbags to withstand the wind from the trains traveling up to 70 mph on their way to the disposal facilities in Oklahoma and Texas. Non-haz material was loaded during the day and sent to a landfill in Nebraska; backfill was brought from the landfill on the return trip.

Verification sampling was handled by the client's representative. PSC then backfilled the area and re-graded the area for handling run-off.

CLIENT:

Union Pacific Railroad

PROJECT LOCATION:

Omaha, Nebraska

PROJECT VALUE:

~$1.6 Million

SERVICES PROVIDED:

Sludge Clean-Up & Disposal

QUALITY ASSURANCE MANUAL

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QUALITY ASSURANCE MANUAL

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QAM	ISO/IEC 17025
1	4.1
2	4.2
3	4.1
4	4.3
5	4.4
6	4.5
7	4.6
8	4.7
9	4.8
10	5.3 and 5.5
11	5.8
12	5.4
13	5.6
14	5.9
15	4.9
16	4.10, 4.11, 4.12
17	4.13 and 5.4
18	4.14
19	4.15
20	5.2
21	5.10
22	NA
Appendix A	NA
Appendix B	NA
Appendix C	NA
Appendix D	5.3 and 5.6
Appendix E	5.5
Appendix F	NA
Appendix G	5.4
Appendix H	5.9
Appendix I	4.3
Appendix J	NA
Appendix K	5.9
Appendix L	NA

1 INTRODUCTION AND SCOPE

1.1 PURPOSE

This Quality Assurance Manual (QAM) describes the policies, procedures and accountabilities established by the Laboratory of ALS Environmental (ALS) to ensure that the test results reported from analysis of air, water, soil, waste, and other matrices are reliable and of known and documented quality. This document describes the quality assurance and quality control procedures followed to generate reliable analytical data.

This QAM is designed to be an overview of ALS operations. Detailed methodologies and practices are written in ALS Standard Operating Procedures (ALS SOPs). Where appropriate, ALS SOPs are referenced in this document to direct the reader to more complete information. A list of current ALS SOPs is found in Appendix G

ALS maintains certifications pertaining to various commercial and government entities; these are listed in Appendix I. Each certification requires that the laboratory continue to perform at levels specified by the programs issuing certification. Program requirements can be rigorous; they include performance evaluations as well as annual audits of the laboratory to verify compliance.

ALS is a full service environmental and radiochemistry laboratory, performing analyses for organic, inorganic, and radiological constituents in a variety of matrices. ALS specializes in serving the Department of Energy (DOE), Department of Defense (DoD), and architect-engineering firms. ALS routinely provides hardcopy data packages and electronic data deliverables that are easily validated by external validators.

The management team at ALS applies an integrated approach to quality assurance, client service, and efficient operations that enables ALS to produce compliant data that meet or exceed all technical and service requirements as prescribed by our clients. This Quality Assurance Manual (QAM) defines ALS's quality assurance (QA) program, and communicates ALS's goals, values and policies regarding quality, ethical conduct, data integrity, and optimized operations. ALS management is committed to continual improvement by implementing the management systems set forth in this QAM and the following documents: ISO 17025;2005, TNI 2009, AIHA LAP Policies, and DoD/DOE QSM.

Documents and forms used in the laboratory may still have previous ownership names like ATI, PAI, Paragon Analytical, DataChem or DCL. These former names can be used until revisions to specific documents are needed

ALS policy is to perform work for clients in the most efficient manner possible, avoiding waste of resources and undue pressure on employees. It is the role of

both ALS management and employees to ensure that work for clients is performed most efficiently and effectively by properly utilizing ALS purchased materials, equipment, and the time and ability of personnel.

1.2 MISSION STATEMENT

To help our customers make informed decisions by providing testing and technical services.

1.3 VISION STATEMENT

To be recognized as a global market leader.

1.4 STATEMENT ON WASTE, ABUSE AND FRAUD

ALS is committed to achieving our goals in the most efficient and effective manner possible, thus avoiding wasteful use of resources. This is accomplished by assuring the proper utilization of ALS's purchased materials and equipment, and time and ability of our personnel. *Any ALS employee, who has any suggestion or concern regarding ALS's practices, is encouraged to discuss his/her idea or question with the Laboratory Director, the Quality Assurance Manager, and supervisor*. A means of confidentially reporting concerns anonymously is also available. Grievances and allegations of unethical conduct will be fully investigated, and appropriate actions taken.

Training regarding ALS's Waste, Abuse and Fraud policies is provided to every new staff member, and to all employees lab-wide as an annual refresher. ALS's policies regarding waste, abuse and fraud are included in ALS SOP 143 and CE-GEN-001.

1.4.1 Code of Ethics and Data Integrity Statements

ALS is responsible for creating a work environment that enables all employees to perform their duties in an ethical manner. *It is ALS's expectation that all employees exhibit professionalism and respect for clients and each other in all interactions and tasks.* ALS requires that each employee abide by the following guidelines:

- Every ALS employee is responsible for the propriety and consequences of his or her actions. Each employee shall conduct him or herself in a professional manner towards all clients, regulators, auditors, vendors, and other employees. Professional conduct relates to honesty, integrity, respect, and tolerance for cultural diversity.

- Every ALS employee shall perform all assigned duties in accordance with ALS's established quality assurance policies and quality control

procedures that have been developed to ensure conformance with contractual and regulatory requirements.

- ALS expects all employees to use professional judgment and to document all situations thoroughly. It is the responsibility of each ALS employee to consult the Laboratory Director or Quality Assurance Manager when atypical or unusual situations occur and to disclose and document the decision-making process. Every employee must disclose any instance of noncompliance. ALS reports all noncompliance issues affecting data to the client.

- It is the responsibility of each ALS employee to report any suspicion of unethical conduct to the Quality Assurance Manager or the Laboratory Director.

- Procedures addressing Ethics and Data Integrity provide assurance that a highly ethical approach to testing is a key component of all laboratory planning, training and implementation of methods. See ALS SOPs 143 and CE-GEN-001.

- *Strict adherence to ALS's Code of Ethics and Data Integrity is essential to the reputation and continued health of our business.* All ALS employees are required to acknowledge their responsibility and intent to behave in an ethical manner by attesting to the requirements described in procedures and annual refresher training is conducted.

2 ORGANIZATION

The Laboratory is organized around the functions described in the following sections. Appendix B of this Quality Assurance Manual contains a detailed organization chart for this laboratory. The laboratory is part of ALS USA Corp and the Laboratory Director reports to the Director of Operations, USA. There are other support functions such as human resources, accounting, safety oversight and computer systems that are provided to the laboratory by corporate entities but none of which is responsible for managing laboratory activities. The support functions of this laboratory involved with testing and services are under the direction of the laboratory director.

The ALS laboratory employs sufficient personnel to complete required chemical analyses and support activities. Support activities include personnel recruiting and management, sample receiving and logging, computer programming and data processing, analytical report preparation, equipment procurement, and method development.

3 MANAGEMENT

This section provides an overview of ALS organization and defines key personnel, their responsibilities, and the lines of communication between these employees. An organization chart that illustrates reporting relationships is provided in Appendix B

3.1 KEY PERSONNEL

Education, experience and skill requirements for these positions are addressed in job descriptions (Title). Functional responsibilities are further discussed below.

In the event of a temporary absence, key personnel must notify other key staff of their absence and reassign their duties to another employee (deputy) who will perform the assigned duties. For example, a PM may assign another PM to cover his or her duties; Group Leader may assign a senior chemist to cover his or her duties; and the Laboratory Director may assign a qualified employee to cover his or her duties

3.1.1 Laboratory Director

The Laboratory Director (Laboratory Director) is responsible for:

- All laboratory operations, including: business functions such as marketing, sales and financial issues. Providing input and support to proposal processes, including interacting with the Sales, Technical and Quality Assurance staff, to ensure that the laboratory is capable of complying with client and regulatory requirements;
- Supervising all personnel through Management staff, who ensure that QA/QC procedures are being performed and that any non-conformances or discrepancies are documented and remedied properly and promptly;
- Ensuring that corrective actions relating to Findings from internal and external audits are completed in a timely fashion;
- Ensuring that the laboratory has the appropriate resources and facilities to perform analytical services;
- Ensuring that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory;
- Defining the minimum level of education, experience, and skills necessary for all positions in the laboratory;
- Ensuring that only those vendors and supplies that are of adequate quality are used; and

- Directing the performance of the annual Managerial Review
- Providing technical education and training to personnel, authorizing personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited, and providing documentation of employee capability and training, and ensuring that training and documentation are up to date;
- Reviewing RFPs and assisting in the preparation and submission of proposals; and
- Interacting with all phases of laboratory operations, including Quality Assurance, Information Systems, and Health and Safety,
- Ensure that the laboratory is capable of complying with client and regulatory requirements.

3.1.2 Quality Assurance Manager

The Quality Assurance Manager reports to the Laboratory Director and is independent of daily operation and production requirements. Therefore, the Quality Assurance Department is able to evaluate data objectively and perform assessments without production influence. *This position has authority to stop work if systems are sufficiently out of control to compromise the integrity of the data generated.*

The Quality Assurance Manager shall have documented training and/or experience in QA/QC procedures; knowledge of quality systems as defined by TNI and other management systems standards; and a general knowledge of the analytical test methods for which data review is performed.

The Quality Assurance Manager (and/or designee) is responsible for:

- Defining and implementing the quality system;
- Developing and maintaining a pro-active program for prevention and detection of improper, unethical, or illegal practices (e.g., single- or double-blind proficiency testing studies, electronic data audits, maintaining documents that identify appropriate and inappropriate laboratory and data manipulation practices);
- Ensuring continuous improvement of laboratory procedures via training, control charts, proficiency testing studies, internal audits, and external audits;
- Coordinating the laboratory's participation in state and Federal certification programs;

- Scheduling the review and distribution and maintaining distribution records of controlled documents, including plans (e.g., Quality Assurance Manuals, etc.) and SOPs;
- Reviewing, when requested, Requests For Proposal (RFPs) to ensure ALS compliance with required QA/QC practices;
- Facilitating external audits;
- Overseeing or conducting internal audits of the entire operation annually (technical, management system, data, electronic);
- Coordinating, preparing and approving external and internal audit responses and corrective actions;
- Managing the laboratory's participation in proficiency testing (PT/PAT) studies;
- Reviewing non-conformances and approving corrective actions;
- Reviewing QC limits per established procedures;
- Ensuring that Detection Limit studies are performed and documented per requirements;
- Managing the reference standards used in the calibration and/or verification of support equipment (e.g., weights, thermometers, balances);
- Revising the Quality Assurance Manual annually in accordance with industry standards;
- Maintaining an archival system for quality records; and
- Maintaining technical and quality assurance training records, including employee authorizations and competency to perform testing.
- Ensure implementation of quality policy and applicable standards.
- Understand, monitor and evaluate the quality assurance (QA) and quality control (QC) activities described in this QAM and its references, reporting deficiencies and identifying resource requirements to the Laboratory Director.
- Conduct reviews or update laboratory Standard Operating Procedures (SOPs).
- Arrange for the analysis performance evaluation (PE/PAT) samples.
- Maintain a record of ongoing personnel training for QAM-related activities, reporting training deficiencies to the Laboratory Director.
- Maintain the laboratory records of nonconformance, corrective action, preventive action and improvement.

3.1.3 The Radiation Safety Officer (RSO) Responsibilities and Health and Safety Responsibilities for assigned personnel.

This position reports directly to the Laboratory Director. The person assigned is responsible for establishing and monitoring adequate systems, procedures and training to ensure that the laboratory staff, facilities and operational activities conducted, function in a manner that minimizes employee risk of illness and injury, is compliant with all applicable regulations pertaining to matters of safety and health, and that limits the financial liability of the corporation as it relates to these matters. The RSO/HSO is also responsible for discharging the duties and requirements prescribed by ALS's Radioactive Materials License.

Key responsibilities for Health & Safety include:

- Ensuring that all employees have sufficient training to perform their job without unnecessary risk of illness or injury, providing health and safety training for new employees, and maintaining health and safety-related training records;
- Providing CPR and other similar training to make certain trained staff is on site to respond to emergency situations.
- Procuring necessary Personal Protective Equipment (PPE) to safeguard laboratory personnel.
- Providing procedural guidance in the form of the Chemical Hygiene Plan (CHP), Radiation Protection Plan (RPP), Respiratory Protection Plan (ResPP), Emergency and Contingency Plan (ECP) and Health and Safety SOPs, and ensuring that these guidances are reviewed by laboratory staff;
- Ensuring that the laboratory facilities are maintained and operated in a safe manner, including:
    - Reviewing routine safety inspections of all operational areas;
    - Performing personal monitoring, as indicated, for chemical and other exposures.
    - Conducting monthly Safety Committee meetings, including discussion and resolution of safety concerns
    - Verifying building security

Key responsibilities for RSO include:

- Ensuring that all employees have sufficient training to perform their job without unnecessary risk of illness or injury, providing radiation safety, training for new employees, and maintaining training records;

- Ensuring that the laboratory facilities are maintained and operated in a safe manner, including:

    - Performing routine radiation surveys and managing the radiation dosimetry program; and

    - Performing personal monitoring, as indicated, for chemical and other exposures.

- Maintaining the laboratory's Colorado Radioactive Materials License and ensuring compliance with the terms of the license. Included in this responsibility are:

    - Procuring and managing radioactive sources and standards;

    - Maintaining the laboratory's radioactive materials inventory, which also includes directing prescreen analyses that provide initial characterization of potential sample radioactivity;

    - Overseeing permitted low level radioactive materials releases to the sanitary sewer; and

    - Ensuring that radioactive materials waste is transported in accordance with all Federal and state regulations, and is transferred only to facilities that possess a radioactive materials license.

3.1.4 Laboratory Information Management Systems Manager

The Information Systems (IS) Manager (Manager) reports to the Laboratory Director. This Manager is responsible for administering the network, maintaining data recovery systems, and for managing personal computing (PC) equipment and peripherals, thus supporting instrumentation and LIMS. The IS Manager (and/or designee) is responsible for:

- Managing and maintaining the laboratory computer system. This function includes determining and purchasing appropriate hardware and verifying that its function meets intended objectives, establishing network server structure, and developing and implementing proper maintenance and backup procedures;

- Procuring, configuring and maintaining all printers and copiers;

- Serving as a technical resource on computer-related issues;
- Documenting related operating procedures through SOPs, manuals or other proprietary documentation;
- Supervising recovery of all systems in the event of a disaster;
- Analyzing information flow in the laboratory and suggesting the most effective hardware, applications software, and/or programming changes as solutions to meet long-term customer requirements; also, implementing those changes in data acquisition and management by purchasing hardware or software, where software is not developed internally; and
- Maintaining and implementing existing and future communications systems, including all internet and telephone systems.
- Developing, maintaining, enhancing the Laboratory Information Management System (LIMS), and other data base programs to facilitate and streamline Laboratory operations

3.1.5 Project Manager

Project Managers report to the Laboratory Director. *The Project Manager serves as the primary point of contact between clients and ALS.* Client communication procedures and documentation requirements are listed in the ALS SOP 997. Each PM (and/or designee) is responsible for:

- Managing and coordinating the laboratory's performance after contract award, by defining technical and service requirements for personnel via LIMS, and interacting with clients and laboratory personnel to ensure that technical criteria and client service needs are met, including monitoring holding times (if appropriate) and deliverable deadlines, for all project sample analyses;
- Reviewing and approving any non-conformances reported by the laboratory and notifying the client, if appropriate, and communicating with clients pro-actively to ensure that all client service and technical concerns are resolved promptly;
- Reviewing all final reports for completeness, compliance with project requirements, clerical accuracy, and reasonableness;
- Generating, as directed by prompts provided in ALS's EDD generator, and transmitting EDDs to their clients as required;
- Ensure communications with the clients are in compliance with ALS SOP 997 "Client Communication"; and

- Communicating to the Laboratory Director any potential need for new or improved capabilities based on clients' feedback.
- Ensure implementation of quality policy and applicable standards.
- Complete and distribute project related information for each project before the laboratory starts work on the project.
- Immediately communicate to the laboratory changes made to projects in progress and document these changes as appropriate.
- Respond to client requests for information and coordinate responses to client audits.
- Perform an initial review of results for large projects to verify that data reports submitted to the client meet all project requirements

3.1.6 Group Leader

- Technical functions such as sample control, preparation, analysis, data management; and quality assurance;
- Monitoring QA/QC standards of performance, including ensuring that corrective actions are developed, documented, and implemented for all external and internal audit Findings, PT study failures, and other corrective actions;
- Monitoring the validity of the analyses performed and data generated in the laboratory to ensure the production of compliant data, including, contributing to and/or overseeing data review processes;
- Ensure that SOPs are compliant with promulgated methodologies and reflect current practice;
- Providing input to the Laboratory Director regarding methodologies, personnel resources, software, and instrumentation; and assisting in the evaluation and/or development of new methods and technologies that improve ALS's ability to meet clients' needs;
- Reviewing RFPs and assisting in the preparation and submission of proposals; and
- Interacting with Quality Assurance, Information Systems, and Health and Safety to ensure that the laboratory is capable of complying with client and regulatory requirements.
- Coordinating and approving the purchase of reagents, standards, glassware, and equipment that meet requirements

- Maintaining current, compliant RVS QC samples for all methods, matrices, analytes, columns, and instruments
- Develop training plans and assigning job tasks and prioritizing analyses;
- Authorize technical staff to perform analyses, including assigning technical SOPs, and providing the QA department with Initial Demonstration of Competency documentation.
- Developing and implementing a preventive maintenance program for instrumentation in their laboratory, and ensuring that all equipment is maintained, serviced, and properly calibrated;

3.2 GENERAL TECHNICAL PERSONNEL

A Chemist (Analyst) or technician reports to the Group Leader or Lab Manager. This employee performs work in accordance with ALS's controlled documents (e.g., SOPs, QAM, etc.) and project-specific requirements as defined by the applicable LIMS specification. *ALS believes that quality begins at the bench.* Accordingly, these employees are key contributors to ALS's success.

A chemist or technician is responsible for:

- Demonstrating proficiency in the analyses for which they are responsible and documenting this demonstration of proficiency in accordance with ALS Standard Operating Procedure 150;
- Performing analyses, recording all data accurately, directly, and promptly, and interpreting and reviewing data according to established procedures;
- Read and understand all assigned SOPs and plan documents;
- Follow Quality Assurance requirements as outlined in the QAM and SOPs. Follow appropriate channels regarding modification of existing SOPs.
- Complying with all QA/QC requirements that pertain to their job function;
- Complying with all health, safety, and waste disposal requirements, as applicable;
- Maintaining and repairing instrumentation;
- Demonstrating good house-keeping practices;
- Follow appropriate protocols when the results for QC samples and/or check standards do not meet acceptance criteria. Disclosing all instances of non-conformances promptly and in writing using the NCR process (ALS SOP 928);
- Participating in training sessions.

- Be familiar with current quality systems and policies as established by management. To comply with these requirements, analysts are responsible but not limited to the following;
  - Follow project requirements as delineated by project managers to ensure analyses are performed as requested.
  - Develop knowledge and understanding of the QAM requirements under which samples are analyzed.
  - Notify managers and Quality Assurance personnel when QA problems arise.
  - Ensure that applicable data are included in each data package in accordance with applicable SOPs.
  - Apply integrity and professional judgment when dealing with analytical processes and laboratory operations.

4 DOCUMENT CONTROL

Current copies of pertinent quality assurance guidance documents, such as ALS's QAM, the TNI Standards, ISO 17025:2005, , the US DoD Quality Systems Manual (QSM),AIHA and others, are posted to the ALS intranet so that they are accessible to every employee. Laboratory Standard Operating Procedures (SOPs) and other method references are also posted to the intranet for lab-wide employee access. Project-specific requirements are disseminated to the laboratory via Laboratory Information Management Systems (LIMS) program specifications.

An overview explaining document hierarchy is in ALS SOP 143. ALS SOP 926 provides detailed guidance on the review, revision, and distribution of laboratory-generated controlled documents.

New and revised documents are posted to the intranet to share with all employees. The LIMS notifies personnel of all revised documents. It is the responsibility of all employees to read and update reading records for all assigned controlled documents. Archival records of all document iterations are maintained by the Quality Assurance Department.

This process of revision, approval and distribution is established in the ALS SOP 926. A list of current SOPs is provided in Appendix G. The Quality Assurance Department manages the review, revision and controlled distribution of documents and maintains associated records.

4.1 LABORATORY QUALITY ASSURANCE PLAN

The QAM is an encompassing controlled-document that describes the ALS quality assurance programs and policies. All systems, policies, and procedures have been developed and implemented in accordance with applicable USEPA requirements, regulations, and guidance from current TNI Standard, ISO/IEC 17025:2005,AIHA LAP Policies, DoD QSM and DOE QSAS documents.

This document has been prepared in accordance with these referenced documents, as well as others, cited in the attached Bibliography. The QAM is intended to provide a 'quality requirements framework', including quality control (QC) procedures to be followed in the absence of reference method and project-specific requirements.

The Quality Assurance Manager bears primary responsibility for ensuring that the QAM meets industry standards. Proposed revisions to the QAM are approved by key laboratory personnel.

4.2 STANDARD OPERATING PROCEDURES

The second kind of controlled-document in the hierarchy of quality assurance guidance is the Standard Operating Procedures (SOPs). An SOP defines the QA/QC requirements for each method and describes in detail how personnel perform procedures and evaluate data. SOPs pertaining to general practices, administrative procedures and health & safety requirements are also maintained by ALS QA Department. It is ALS's intent that the information contained in our SOPs is both method-compliant, and accurately reflect actual practice.

4.3 LABORATORY MANAGEMENT INFORMATION SYSTEMS (LIMS) PROGRAM SPECIFICATION

The last and most specific controlled-document in this hierarchy is the LIMS program specification. The LIMS program specification is a distillation of client Quality Assurance Project Plan (QAPjP) or contractual requirements, prepared electronically by the ALS Project Manager (PM), in collaboration with the Quality Assurance Manager and applicable operations management. This custom program specification, along with the associated LIMS test code nicknames, contains directives and controls that govern testing and reporting data. The program specification is often limited in scope and addresses only those QA/QC criteria required for a specific project. When the client's requirements differ from those stated in the SOPs and/or QAM, the project-specific LIMS program specification requirements supersede the others.

5 REVIEW OF REQUESTS, TENDERS AND CONTRACTS

Project Managers are responsible for maintaining, archiving, and retrieving all contracts, project requirements and QAPPs provided to ALS by clients and related to projects completed by ALS.. Specific procedures for client communication and required documentation are listed in the ALS SOP 997, "Client Communication."

6 SUBCONTRACTING OF TESTS

ALS strives to identify the need to subcontract specific analytical procedures during the bid response process. Analyses may also need to be subcontracted, however, in cases of emergency where the ability to meet sample holding time criteria is endangered. In these instances, ALS compiles a list of qualified subcontract laboratories that are suitable to perform the needed analyses.

ALS's Project Manager must receive permission from the client, in writing, before the subcontract laboratory can be procured and samples forwarded to the laboratory. See ALS SOP 103 for guidance on evaluating a subcontract laboratory's qualifications. Detailed procedures pertaining to submitting samples to a subcontract laboratory are provided in ALS SOP 103.

Procedures and documentation for using sub-contract laboratories are listed in the ALS SOP 997 "Client Communication." All results provided to ALS by a subcontract laboratory are identified clearly in the analytical report to the ALS client. Under no circumstances will ALS PT samples be sent to a subcontract laboratory.

7 PURCHASING SERVICES AND SUPPLIES

ALS uses vendors which supply the level of quality required to perform testing activities. ALS maintains a relationship with multiple vendors and looks for vendors with comparable certifications or accreditations. The laboratory monitors compressed gases used through system performance (e.g. background, blanks, calibrations criteria, detection limits). Any out of specification compressed gases are documented as nonconformance. Procedures designed to ensure that materials and services purchased meet the quality specifications of ALS delineated in ALS SOP 127.

8 SERVICE TO THE CLIENT

At ALS, improvement of the quality systems and preventative action is effected through an ongoing systems review by management using input for all staff.

ALS actively seeks employee and client input for improvements through surveys and questionnaires. Internally, ALS maintains a process improvement website for employees to provide suggestions for improvements. For clients, ALS surveys and gains feedback on services provided. This input to management is managed at a corporate level.

Project managers are especially involved in the production and assurance of quality results. Client Communication Procedures and documentation requirements are listed in ALS SOP 997.

9 COMPLAINTS

The focal point of contact with the client is the ALS Project Manager. If a complaint or any circumstance raises doubt concerning ALS's compliance with its policies or procedures, or with the requirement of a method or quality system, it is the Project Manager who initiates a client inquiry or nonconformance through the ALS LIMS NCR system following the ALS SOP 928. ALS will respond to all complaints in a timely fashion.

10 FACILITIES AND EQUIPMENT

Appendix D contains a diagram of the ALS laboratory facility. ALS maintains constant and consistent test conditions throughout the facility (e.g., temperature, air purification, and lighting). All entrances and exits are wired to a laboratory-wide security system that is monitored continuously. Access to the laboratory area from the front offices is restricted by means of keypad locks requiring numeric security code entry. Visitors must sign in at the front desk and must be escorted at all times (some vendors are allowed access without continuous escort, in order to facilitate repairs or deliveries). Further details pertaining to building security are provided in **ALS SOP 132**.

The following sections highlight areas of the laboratory that are involved with sample receipt, handling, preparation, and analysis of samples.

10.1 SAMPLE RECEIPT AREAS

ALS's sample receiving area consists of a large dedicated room of more than 500 ft^2. It contains fume extraction and radiation survey equipment to safely handle incoming radioactive and mixed waste samples. There is an outside access door to facilitate sample delivery and shipping of sample kits. Adjacent to the sample receiving area is the bottle storage room and the radioactivity prescreening lab.

10.2 SAMPLE STORAGE AREAS

ALS's sample receiving area has a walk-in cooler and a freezer that are used for temporary storage of samples that require thermal preservation. In addition, there are several designated sample storage locations throughout the laboratory that are used to store samples scheduled for specific analyses (see section 11 for further details). An alarm system in the walk-in coolers notifies the Laboratory Manager of any temperature excursions. See ALS SOP 326.

10.3 SAMPLE PREPARATION AREAS

The laboratory has nine sample preparation/extraction/digestion areas. These areas are divided as follows: six radiochemistry preparation laboratories; two organics extraction laboratories; one metals digestion laboratory, and one Wet Chemistry laboratory. The total floor space of these six laboratories is approximately 4500 ft^2.

Laboratory preparation procedures are segregated as much as possible to minimize the potential for contamination, maximize processing efficiency, and maintain analytical integrity. Rigorous cleaning of glassware and apparatus ensures that cross-contamination is minimized. Each laboratory area has a dedicated or locally shared HVAC system that continuously exchanges the laboratory air with filtered and conditioned outside air. There are 44 (including Niederman arms) laboratory hoods in the six sample preparation areas, and each sample preparation area has at least one hood. See HSE Hood for specific details related to fume hood monitoring.

10.4 STANDARDS PREPARATION AREAS

A dedicated radiochemical standards preparations room and an organics standards preparation area are maintained. Metals and inorganic standards are stored independently from sample storage areas and are prepared in their respective laboratory areas.

10.5 ANALYTICAL LABORATORIES

The ALS facility houses a volatile organics analysis (VOAs) laboratory that is on an upper level of the building, away from all other laboratory operations. The ALS facility also houses one general chemistry (WetChem) laboratory, two radiochemical counting rooms, a total organic carbon (TOC) laboratory area, two gas chromatograph (GC) laboratory area, a semivolatile organic compounds (SVOCs) laboratory, and a metals laboratory that contains separate inductively coupled plasma (ICP), mercury, and inductively coupled plasma/mass spectrometry (ICP/MS) rooms.

10.6 OTHER LABORATORY AREAS

Other areas of the ALS facility include a tank room for compressed gasses, several waste management areas, telephone and computer storage rooms, staff offices, Reporting Group and Reports Management data processing rooms, and various scanning/reproduction and supply storage areas.

10.7 DEIONIZED WATER SYSTEM

Within the laboratory, there are two main deionized (DI) water distribution systems available for glassware cleaning, bulk reagent preparation, and

general use. One system is located in the janitor's area and serves the radiochemistry side of the facility (ASTM Type II water generated). The other system is located adjacent to the metals laboratory area and serves the stable chemistry side of the facility (ASTM Type I water generated).

ALS SOP 319 provides detailed information pertaining to ALS's DI water systems, including independent testing to verify that electronic readouts of water quality are accurate, maintenance by a vendor contractor, and corrective measures to be taken should water quality degrade to below acceptable limits.

10.8 ANALYTICAL EQUIPMENT

ALS maintains an organized maintenance program that is broader than the particular instruments or devices a specific employee may operate or is familiar with. The objective of ALS's equipment maintenance program is to provide a structure of care that prevents quality control failures and minimizes lost productivity that results from equipment malfunction or failure. Within this program are provisions for corrective actions, maintaining spare parts, and a contingency plan in the event of catastrophic failure (e.g., loss of power for a significant period of time

See Appendix E for a comprehensive list of ALS's equipment.

10.9 PREVENTIVE MAINTENANCE

ALS's maintenance program is based on equipment manufacturer's recommendations, operator training guidance, and other considerations

Provisions for documenting all routine and non-routine instrument equipment maintenance and repairs are also established within the maintenance program.

Responsibilities for applying ALS's maintenance program rests with the department that utilizes the equipment, the Quality Assurance Department bears responsibility for certain support equipment such as balances, weights and temperature measurement devices. Only authorized personnel are permitted to perform maintenance.

In general, ALS performs maintenance as needed (including preventive considerations). Certain aspects of routine maintenance are considered to be 'operational', and are performed each time the instrument is run. Other maintenance is performed 'periodically'. Each instrument operator is responsible for the performance of their own instrument, and may perform maintenance duties at their discretion.

ALS maintains service contracts for most major analytical equipment. Preventive maintenance is included in most of these service contracts.

10.10 EQUIPMENT DOCUMENTATION REQUIREMENTS

Analysts are responsible for maintaining calibration/verification and maintenance records of all instruments and equipment involved in the creation of the analytical data they generate.

Although the manner of record keeping varies, maintenance records provide a clear and complete history of repairs and maintenance associated with the instrument.

Details regarding equipment documentation are also provided in ALS SOP 303. Maintenance Logbooks are reviewed during internal audits.

10.11 SPARE PARTS

An adequate inventory of spare parts is required to minimize equipment downtime. This inventory should include those parts and supplies that:

- are subject to frequent failure;
- have limited useful lifetimes, or
- cannot be obtained in a timely manner should failure occur.

Departments are responsible for maintaining an adequate inventory of necessary spare parts for all major instruments and equipment items. Examples of spare parts maintained for major instrumentation include: septa, inserts, columns, tube fittings, filaments, source parts, and traps.

10.12 SUPPORT EQUIPMENT

ALS defines support equipment as all those devices which are not the primary determinative instrument defined by the analytical method, which support laboratory operations and would contribute to the testing uncertainty. Support equipment includes balances, temperature measurement devices, and mechanical (e.g., Eppendorf ™ pipets) volumetric measurement. Support equipment affecting the uncertainty of testing results is verified periodically in accordance with applicable procedures. All verification is directly or indirectly traceable to certified reference standards. The results of the calibration/verification are documented.

Because automatic dispensing devices used to deliver solvents or reagents (e.g., for sample preservation and extractions) are not used to deliver critical volumes, these devices are exempt from daily verification.

Additionally, ALS has procedures for the following support equipment:

- Deionized (DI) water systems ALS SOP 319
- Health physics equipment ALS SOPs 012, 016 and 029
- Mechanical Pipettes, ALS SOP 321.

A statement of Accuracy is acquired from the manufacturer for all glass microliter syringes.

The following ALS SOPs provide additional information about calibration and verification of support equipment:

- ALS SOP 305 -- balance calibration and verification
- ALS SOP 320 -- monitoring and recording of oven temperatures
- ALS SOP 326 -- monitoring refrigerator and freezer temperatures

11 SAMPLE MANAGEMENT

11.1 SAMPLE CONTAINERS, PRESERVATION, HANDLING, HOLDING TIMES

Although the laboratory is not responsible for sample collection, it is responsible for maintaining the integrity of the sample after receipt. After the sample has been collected, the constituents of the sample must remain as close as possible to the field condition (i.e., degradation must be prevented). The length of time that these constituents will remain stable is related to their character and the preservation method used. Preservation is accomplished by the addition of chemical preservatives and/or storage at a controlled temperature, and by the strict observation of prescribed maximum holding time allowances. Appendix F lists sample container types, preservation requirements, and holding times.

11.2 FIELD SUPPORT

ALS provides shipping containers, custody documents, custody seals, clean sample bottles, labels, applicable high-purity chemical preservatives for water samples, and trip blanks to support field-sampling events. Hard-sided, insulated, “picnic” coolers are typically used to transport samples from the field to the laboratory. These coolers meet or exceed all protocol

requirements (i.e., USDOT, USEPA, ASTM) for shipping. ALS SOP 205 provides further information on sample kits.

11.3 SAMPLE CONTAINERS

ALS provides certified clean sample bottles for sample collection. Used sample bottles are never used by the laboratory. Containers are stored in clean areas, away from laboratory processes, to prevent exposure to fuels, solvents, and other contaminants.

11.4 SAMPLE PRESERVATION AND HOLDING TIMES

ALS provides the required chemical preservatives for water samples. ALS uses high quality reagent grade chemical preservatives (i.e., acids, solutions, etc.) are added to individual sample bottles, as appropriate per method and US Department of Transportation (DOT) requirements. Holding times begin with the collection of samples and continue until analysis is complete. See Appendix F for a summary of container, preservation and holding time requirements specific to various analyses and matrices.

11.5 SAMPLE RECEIPT SCHEDULE

ALS receives samples six days of the week, Monday through Saturday. ALS requests that clients ship samples for delivery within one day of collection, and give advance notice to the laboratory regarding shipment of RUSH samples or samples with short hold time requirements. Shipping containers received at the laboratory on holidays or after business hours are placed in a walk-in refrigerator and opened on the next business day, unless other arrangements are made in advance.

11.6 CHAIN-OF-CUSTODY

Chain-of-custody (COC) documentation begins with field sampling and continues through laboratory analysis and disposal. A chain-of-custody record that identifies all individuals who handle the sample is used to establish an intact, continuous record of the physical possession, storage, and disposal of collected samples, including their aliquots, extracts or digestates.

To ensure that sample custody objectives of traceability are achieved for every project, the chain-of-custody initiated in the field is continued and maintained internally throughout the laboratory per the requirements specified in ALS SOP 318. Internal chain-of-custody begins with sample acceptance and login. ALS SOP 202 is followed as samples are distributed for use throughout the laboratory and concludes with final sample disposition

ALS applies a unique barcode to each sample bottle received, and maintains several scanners and PCs throughout the laboratory to document and assist with sample, aliquot, extract and digestate movement throughout the facility. This electronic process is accomplished through LIMS, which retains records of all sample and fraction transactions made.

11.7 SAMPLE ACCEPTANCE POLICY

ALS' sample acceptance policy requires that a sample meet the following conditions:

- The sample shall be completely documented (sample identification, location, date and time of collection, collector's name, preservation type, sample type, any special remarks concerning the sample);
- The sample shall be identified by a unique identifier using durable labels completed in indelible ink;
- The sample shall be collected in adequate volume;
- The sample shall be collected in an appropriate container;
- The sample shall be delivered to the laboratory with at least one-half the holding time remaining;
- The sample shall not exceed allowed radioactivity levels; and
- The sample shall not show signs of contamination, breakage, or leakage.

Sample receipt discrepancies are documented by Sample Receiving Department personnel on the Condition of Sample Upon Receipt, Form 201 (ALS SOP 008), which is forwarded to the Project Manager as part of the workorder folder. Where samples do not meet the criteria stated above, the Project Manager requests information from the client before proceeding. If the client can provide the information and, in cases of compromised sample integrity, directs the laboratory to proceed, then data acquired from the sample(s) analysis is reported and the problems noted during sample receipt are disclosed in the narrative of the final data report.

In support of the protection of employee health and of ALS's radioactive materials license, ALS observes prescreening protocols that designate or determine samples with radioactive content. Detailed procedures for conducting radiological survey of incoming sample packages are given in ALS SOP 008, further details regarding prescreening protocols are given in ALS SOP 703.

11.8 SAMPLE RECEIPT PROTOCOLS

Upon receipt of the field samples at the laboratory, personnel ensure that ALS SOP 202 is followed.

Following sample arrival and initial screen for USDOT compliance and removable radioactivity, sample receiving personnel inspect the sample and record any discrepancies using Form 201 from ALS SOP 008.

Sample temperature is verified upon receipt by measuring the temperature of the temperature blank or by measuring the temperature of a representative samples(s) with an infrared (IR) temperature device. See ALS SOP 210 for instructions and procedures related to IR temperature guns. Samples that require thermal preservation are considered acceptable if the temperature upon arrival is between just above freezing to 6ºC. Samples that require thermal preservation but are hand-delivered to the laboratory immediately after collection, may not meet the temperature requirement. If the hand-delivered sample is packed in ice, then Sample Receiving personnel record its temperature and note that the chilling process was initiated.

11.9 SAMPLE STORAGE

Samples requiring thermal preservation are stored in designated refrigerated storage areas that are maintained just above freezing to 6ºC. Freezer storage areas are maintained below freezing. The temperature of refrigeration units is monitored continuously using electronic min/max thermometers and recorded each business day, near to the beginning of the work shift. If the temperature exceeds the prescribed range, then corrective action is taken and documented immediately, and the client notified, if appropriate; see ALS SOP 326 for further details. Directives for corrective action pertaining to catastrophic failure of cooling units (as well as laboratory ovens, etc.) are included in ALS's Emergency and Contingency Plan (ECP).

Samples are stored away from all standards, reagents, food and other sources of contamination. Samples are stored in such a manner as to prevent cross-contamination. For example, pure product or potentially contaminated samples are tagged as "hazardous" and stored within a secured area, separate from other samples. ALS provides designated sample storage areas according to the following parameter groups: metals, inorganics (WetChem), semivolatile organics, volatile organics, fuels, and radiochemical analyses.

Samples having suspected radioactive activity and scheduled also for stable chemical analyses are refrigerated. Samples to receive tritium analyses are refrigerated. Samples designated for radiochemistry analyses *only*, with the exception of tritium, are segregated and maintained at ambient temperature.

To effectively monitor the storage and potential contamination of volatile organic samples, ALS observes a refrigerator blank program as detailed in ALS SOPs 511, 512.

To provide for the safe containment of sample material that could be released as a result of sample container failure, all samples are stored in secondary containment bins. These secondary containment bins are of a sturdy and inert nature, and are sufficient in size to fully contain the sample(s) in the event of a spill, leak or breakage. The bin(s) may be uniquely identified (labeled) to assist in locating samples via the chain-of-custody system. The bins are thoroughly cleaned between uses.

11.10 SAMPLE ACCESS

It is ALS's policy that neither samples nor data may be released to unauthorized personnel. In order to ensure that this policy is maintained, the laboratory facilities are maintained under controlled access and are restricted to authorized personnel only (see ALS SOP 132 for further details pertaining to building security).

11.11 SAMPLE HOMOGENIZATION AND SUBSAMPLING

Obtaining a representative aliquot of sample for testing is critical to the representativeness of the analytical results obtained. Proper subsampling techniques, particularly for solid matrices, are a component of each bench employee's technical instruction. Sample homogenization procedures prior to radiochemical analysis are prescribed in ALS SOP 736. Representative subsampling procedures for stable chemistry analyses is prescribed in ALS SOP 336.Client and method specified procedures for homogenization or aliquotting may also be defined in the applicable LIMS program specification.

11.12 SAMPLE DISPOSAL

After completion of sample analysis and submission of the project report, unused portions of samples are retained by the laboratory for a minimum of 30 days or as designated by client and contract requirements from date of invoice. Samples are disposed or returned to the client according to the nature of the samples and the client's specifications. ALS documents and retains all conditions of disposal and correspondence between all parties concerning the final disposition of the sample.

Samples, digestates, leachates, extracts, and process waste that are characterized as hazardous, radioactive, or mixed waste are disposed in accordance with Federal and state laws and regulations. ALS maintains records to demonstrate that all disposal efforts were conducted in compliance with these laws and regulations. This documentation includes the unique sample identity, date of disposal, nature of disposal (e.g., sample depleted, sample disposed in hazardous waste facility, sample disposed in

mixed waste facility, sample returned to client); and name of the individual responsible for disposal.

12 ANALYTICAL PROCEDURES

ALS is capable of analyzing various matrices, including surface and groundwater, drinking water, soil, sediment, vegetation, tissue, filter and aqueous and solid wastes. Analytical procedures are conducted in strict adherence with SOPs that describe the preparation, analysis, review and reporting of samples. In some cases, these SOPs may also describe proprietary methods developed by ALS and used per the client's request. A list of ALS's analytical capabilities is presented in Appendix F. References for analytical procedures used are presented in the attached Bibliography. ALS also, upon request, develops and validates procedures that are more applicable to a specific client objective.

12.1 ANALYTICAL METHODS

Selection of the appropriate method is dependent upon data usage and regulatory requirements. ALS may modify existing methods in order to:

- achieve project-specific objectives;
- incorporate modifications or improvements in analytical technology;
- address unusual matrices not covered in available methods; and
- provide analytical capabilities for an analyte for which there are no promulgated methodologies.

ALS discloses method modifications to our clients by providing the appropriate SOP for review.

12.2 METHOD COMPLIANCE

Compliance is the proper execution of recognized, documented procedures that are either approved or required. Strict adherence to these procedures is necessary to provide data acceptable to a regulatory body of competent jurisdiction in a specific regulatory context. To ensure method compliance ALS personnel follows SOPs as written and internal audits review methods for regulatory compliance.

12.3 NON-STANDARD METHOD VALIDATION

When a non-promulgated method (i.e., methods other than EPA, ASTM, etc.) is required for specific projects or analytes of interest, or when the laboratory

develops a procedure, the laboratory must establish the validity of the method prior to extracting or analyzing a client's samples. *Validity is established by meeting criteria for precision and accuracy. See ALS SOP 999 for method validation protocols.*

13 MEASUREMENT AND TRACEBILITY

13.1 DATA INTEGRITY AND TRACEABILITY

Data Integrity is the extent to which results can be substantiated by hard-copy documentation, electronic or computer-generated data calculations, computer software, and data generation.

Traceability links final numerical results to authoritative measurement standards (reference materials and reference standards) and that which explicitly describes the processing of each sample from receipt to analysis.

13.2 SENSITIVITY

The term sensitivity is used in a broad sense to describe the various limits that enable a laboratory to meet project-specific data quality objectives (DQOs). These limit types include: instrument detection limit (IDL), method detection limit (MDL), method quantitation limit (MQL) or method reporting limit (RL), contract-required detection limit (CRDL), and contract-required quantitation limit (CRQL).

13.3 LOD (Can be called MDL)

The LOD is a minimum value that addresses the detection capability for the sample preparation procedures and the instrument. Hence, ALS performs ongoing analyses for each preparatory and determinative method combination, matrix, instrument, and analytical column. These analyses of Reporting Limits Verification Samples (RVS) are ongoing in each batch of samples tested. RVS analyses are also required for method validation, and whenever the basic chemistry of a procedure changes.

LOD is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. LODs are determined using ALS SOP 329.

An LOD study is not performed for radiological analyses, or any components for which spiking solutions are not available or relevant (e.g., pH, ignitability, etc.). Reporting limits for these kinds of parameters, where applicable, are established based on the laboratory's knowledge of extraction efficiency, instrument sensitivity, and experience with the procedure.

13.4 LOQ (can be called RL)

ALS defines LOQ as the analyte concentration at or above the lowest standard used for calibration and can be routinely demonstrated and achieved.

The LOQ is the lowest level that can be reliably measured by a laboratory with defined limits of precision and bias. The precision and bias at the LOQ is associated with Reporting Limits verification (RVS) samples analyzed.

The LOQ is verified using reporting limit verification samples (RVS) on either a batch basis or periodically scheduled. This RVS is a clean matrix spiked at the LOQ.

13.5 MINIMUM DETECTABLE CONCENTRATION (RADIOCHEMISTRY)

The minimum detectable concentration (MDC) is used for radiochemical procedures and is defined as the concentration at which there is a 95% confidence that an analyte signal will be distinguishable from an analyte-free sample.
The general formula for calculating the MDC is based on calculations derived by Curie (Curie, L.A., "Limits for Qualitative Detection and Quantitative Determination," Analytical Chemistry 40(3); pp. 586-693; 1968) and is calculated as follows:

$$MDC = \frac{(4.65\, X\, \sigma_b) + 2.71}{T * K}$$

where:

MDC = Minimum Detectable Concentration

σ b = Standard deviation of the measurement background

T = Sample count time

K = Factor for incorporating efficiency, abundance, aliquot yield, ingrowth and decay, and activity conversion factors

13.6 MEASUREMENT UNCERTAINTY

13.6.1 Analytical Uncertainty

Uncertainty is associated with most of the results obtained in the laboratory testing conducted by ALS. It is meaningful to estimate the extent of the uncertainty associated with each result generated by the laboratory.

It is also useful to recognize that this measurement uncertainty is likely to be much less than that associated with sample collection activities. In practice, the uncertainty of a result may arise from

many possible sources. ALS has considered the relative contribution of major sources of error. The approach adopted by the laboratory to estimate uncertainty resulted in the conclusion that many sources of error are insignificant compared to the processes of sample preparation, calibration, and instrumental measurement. The uncertainty associated with these processes can be estimated from quality control data. Accordingly, ALS estimates uncertainty from data derived from quality control samples carried through the entire analytical process. Each estimate of uncertainty is associated with a specific combination of analytical method and sample matrix.

The ALS Standard Operating Procedure 998 gives details of how uncertainty in the analytical process is estimated, calculated and reported if required.

13.6.2 Total Propagated Uncertainty For Radiochemisry

Total propagated uncertainty (TPU), is a summation of the various uncertainties present in a measurement process, and is an integral part of every reported radiochemical value. TPU, reported as ±TPU, is the expressed estimated measure of the total uncertainty inherent in that reported radiochemical result.

The components of the TPU are classified as either random or systematic.

Random uncertainties, also called counting uncertainties (CU), derive from the statistically random (normally distributed) nature of radioactive decay, and are estimated as the square root of the total number of counts acquired during analysis. In cases where the chemical yield is determined by the analysis of a radioactive tracer, the yield uncertainty (YU) is also a random uncertainty, and is estimated as the square root of the total number of tracer counts acquired. CU and YU are calculated in activity units to afford comparability to the sample result.

Systematic uncertainties are attributable to actual errors in the measurement of a physical quantity. For example, if a balance has an accuracy of ±0.1%, the results of those gravimetric measurements are not normally distributed, but rather are assumed to be biased by that amount. Estimates of systematic uncertainties in laboratory processes are somewhat subjective, but should be supported by empirical data whenever possible. Systematic uncertainties associated with the preparation of a sample are called preparation uncertainties (PU), and are defined based on the number of volumetric and gravimetric measurements, quantitative transfers,

etc. Systematic uncertainties associated with the analysis, called instrument uncertainties (IU), include biases associated with sample positioning, standard values, calibration coefficients, etc. PU and IU are typically provided as a percentage of the final result. To afford comparability to sample results, PU and IU are expressed in activity units by multiplying the percentage by the sample activity (A).

ALS SOP 708 provides more information about the calculation and use of TPU.

14 ASSURING THE QUALITY OF RESULTS

14.1 QUALITY ASSURANCE INDICATORS AND OTHER MEASUREMENT PARAMETERS

ALS' objective is the development and implementation of policies and procedures that provide results of known, documented, and appropriate quality. This QAM defines general policies for the analysis, documentation, evaluation, validation, and reporting of data. Specific, detailed procedures for chain-of-custody, calibration of instruments, analysis, reporting, quality control, audits, preventative maintenance, and corrective actions, are provided in SOPs as listed in Appendix G.

The hierarchy of quality control requirements begins with:

- Client Requirements (Program Specifications (LIMS))
- Reference Method and/or SOP requirements
- Guidance from QAM and other general SOPs

In order to produce data of known, documented, and appropriate quality, ALS:

- maintains an effective quality assurance program that measures and verifies laboratory performance;
- evaluates technical and service requirements of all analytical services requests before accepting samples from a client/project. This evaluation includes a review of facilities, instrumentation, staffing, turnaround times, and any project-specific quality control or reporting requirements;
- provides sufficient flexibility to allow controlled changes in routine methodology in order to achieve client-specific data requirements as prescribed in client documents and contracts;
- performs all analyses according to promulgated methods or methods developed and validated by ALS and documented in SOPs;

- recognizes as soon as possible and discloses and corrects any factors that adversely affect data quality; and
- maintains complete records of sample submittal, raw data, laboratory performance, and completed analyses to support reported data.

14.2 DATA QUALITY INDICATORS

Data Quality Indicators (DQIs) are qualitative and quantitative statements developed by data users that specify the quality of data from field and laboratory data collection activities in order to support specific decisions or regulatory actions. The DQIs describe *what* data are needed, *why* the data are needed, and *how* the data will be used to address the problem being investigated. DQIs also establish qualitative and quantitative goals that allow the data user to determine whether the data are of sufficient quality for the intended application.

The principal DQIs are **precision**, **accuracy and bias**, **representativeness**, **completeness**, and **comparability** (i.e., the PARCC parameters). The following sections define and describe the application of these parameters. The QA/QC protocols used for the majority of analyses are adopted from SW-846 and 40 CFR methodologies, the USEPA Organics and Inorganics CLP SOWs, and various radiochemistry guidances, which contain detailed descriptions of the quality control measures routinely employed.

14.3 PRECISION

Precision is an expression of the reproducibility or degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions.

Analytical precision is a measurement of the variability associated with duplicate or replicate analyses of the same sample in the laboratory. Analytical precision is determined by the analysis of matrix spike/matrix spike duplicates (MS/MSD), laboratory control sample pairs (LCS/LCSD), or by unspiked duplicate samples (DUPs). Total precision is a measurement of the variability associated with the entire sampling and analysis process, and is determined by analysis of duplicate or replicate *field* samples, thus incorporating the variability introduced by both the field and laboratory operations.

Precision is independent of bias or accuracy, and reflects only the degree to which the measurements agree *with one another*, not the degree to which they agree with the true or accepted value of the parameter measured. Precision for chemistry analyses is typically expressed as relative percent difference (RPD), as defined below:

$$RPD(\%) = \frac{X_1 - X_2}{(X_1 + X_2)/2} \quad (100)$$

where:

RPD = Relative Percent Difference

X_1, X_2 = analyte value of sample 1 and sample 2

Precision, for radiochemical analyses, is typically measured in terms of Duplicate Error Ratio (DER), calculated as follows:

$$DER = \frac{|S - D|}{2 * \sqrt{\sigma^2{}_S + \sigma^2{}_D}}$$

where:

DER = Duplicate Error Ratio

S, D = analyte values of (S)ample and (D)uplicate

σ = One Sigma error value associated with sample result

RPDs or DERs are compared to the control limits established for the analysis method, or other quality control criteria as prescribed in the applicable LIMS program specification. Precision objectives vary per analytical method. Sample homogeneity/non-homogeneity is an important factor that influences the precision of duplicate sample results.

14.4 ACCURACY and BIAS

Accuracy is agreement between the measured and true (known or accepted reference) value.

Bias describes the systematic error of a measurement process that causes errors in one direction from the true value. Sources of bias include are usually systematic and maybe limitations of the method, matrix or analytical technology. *Bias is **not** equivalent to accuracy.*

Accuracy is typically measured by determining the bias (percent recovery) of known target analytes that are spiked into a field sample or reagent water or simulated solid matrix (laboratory control sample). Surrogate recovery is reported and is used to assess method performance for each sample analyzed for volatile and semivolatile organic compounds. For organic and inorganic parameters, the stated accuracy objectives apply to spiking levels at or near the midpoint of the calibration curve. For radiochemical analyses, the spiking levels for the control spikes may vary from five to fifty times the method reporting limit.

Percent recovery is calculated as:

$$R(\%) = \frac{(C_1 - C_2)(100)}{C_3}$$

where:

R% = Spike amount recovered

C_1 = Concentration of analyte in spiked sample

C_2 = Concentration of analyte in unspiked sample

C_3 = Concentration of spike added

Acceptance limits are usually based upon established laboratory control samples from similar matrices. Other quality control criteria may be prescribed in the applicable LIMS program specification. Recoveries outside the established limits may indicate some assignable cause other than normal measurement error, and the need for corrective action.

Both bias and precision are calculated for each batch and the associated sample results must be interpreted by considering theses specific measures. The quality assurance objectives for precision and bias are to achieve the quality control acceptance criteria specified in the appropriate analytical procedure.

For organic analyses, precision and accuracy are determined by using matrix spike and matrix spike duplicate samples and/or surrogate spike compounds and laboratory control samples. For inorganic analyses, precision and accuracy are determined by using duplicate samples or matrix spike duplicate samples (precision) and matrix spike and laboratory control samples (accuracy). For radiological analyses, precision and accuracy are determined from the results of duplicate samples or matrix spike duplicate samples (precision), laboratory control sample duplicates (precision) and laboratory control samples (accuracy).

QC limits for accuracy and precision are be developed from intra-laboratory historical data, adopted from prescribed limits required by the client or from the reference method. If quality control acceptance criteria do not exist for a given method, then the laboratory may establish advisory control limits derived from a minimum of four data points. Until verified by a statistically significant data population, the control limits will be considered as advisory limits only, and the laboratory will not automatically initiate reanalysis if these limits are not achieved. See Section 16.2 for further discussion of control limits and control charts.

14.5 REPRESENTATIVENESS

Representativeness is a qualitative element. It expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

Sample handling protocols (e.g., holding times, storage, preservation and transportation) have been developed to preserve the representativeness of the samples. Proper documentation establishes that quality control protocols have been followed, and sample identification and integrity are ensured. SUB-sampling is addressed in ALS SOPs 336 and 736.

14.6 COMPARABILITY

Comparability is a qualitative expression of the confidence with which one data set can be compared to another. Comparability is achieved by:

- following established, standardized, and approved sample collection techniques and analytical methods;
- achieving holding times;
- reporting results in common units;
- using consistent detection levels; and
- Reporting data according to consistent rules.

14.7 COMPLETENESS

Completeness is an expression of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Completeness is the percentage of measurements that are judged to be usable (i.e., that meet project-specific requirements). Completeness goals are defined in the site sampling and analysis plan, QAPjP or contract, and vary with the size and complexity of the project. Completeness goals of 80-95% are traditionally accepted as realistic. ALS's objective is 100% completeness for samples unaffected by matrix interferences.

14.8 QUALITY ASSURANCE PROCEDURES

ALS' quality control program provides a systematic process that enables the laboratory to evaluate and control the validity of analytical results, by measuring and monitoring accuracy and precision by method and matrix; by developing control limits and using these limits to detect errors or out-of-control events; and by requiring corrective actions to prevent or minimize the recurrence of these events. ALS observes QC procedures to ensure that sample data meet laboratory and client quality objectives.

The purpose of preparing and analyzing QC samples is to demonstrate accuracy and precision of the sample data and performance of the method for the target analytes being investigated. Acceptance criteria may be dictated by reference methods or by project requirements.

For all analyses performed by ALS, the QC concepts and samples described in the following sections are mandatory. Determinative SOPs contain a Table that summarizes the types and frequency of QC samples, acceptance criteria, and corrective actions required.

14.9 DEFINITIONS OF BATCH and BATCH QC SAMPLES

14.9.1 Preparation Batch

A preparation batch consists of as many as 20 field samples of the same or similar matrix that are prepared together by the same analyst(s) within a limited or continuous time period, following the same method, and using the same kind of equipment and same lots of reagents. Additional samples may be added to a batch if the appropriate number and kind of method control samples (e.g., MB, LCS) and matrix-specific QC samples (e.g., MS/MSD, DUP). Cleanup procedures may be included as part of the preparation batch. All field and QC samples in the batch shall be subjected to the same preparation and cleanup procedures. For industrial hygiene samples a Reagent Blank, Method Blank, RVS and duplicate Laboratory Control Samples (LCS/LCSD) are used in each preparation batch.

14.9.2 Analysis Batch

The analysis batch (or sequence) consists of samples, may be multiple preparation batches that are analyzed together within the same or continuous time period, on the same instrument, and processed using the same calibration. Each analysis sequence must contain the appropriate number and kind of standards and samples as defined by the method.

Where no sample pre-treatment (such as extraction or digestion) is required prior to analysis (e.g., analysis of volatile organic compounds, anions analysis by ion chromatography, etc.), the preparation batch and analysis sequence are equivalent.

14.9.3 Preparation Batch QC Samples and Standards – Definition and Use

The results of quality control samples provide an estimate of accuracy and precision for the preparation and analysis steps of sample

handling. The following sections describe the QC information provided by each of these analytical measurements.

14.9.4 Method Blank

A method blank (MB) consists of an aliquot of well-characterized, controlled, or certified matrix (e.g., reagent water, Ottawa sand, solid reference material, boiling chips) that is processed through the entire sample preparation, cleanup, and analysis procedure. For radiochemical analyses, a suitable blank solid matrix has not been identified; therefore, reagent water is routinely used for the blank for most solid matrices. The volume or weight of the blank must be approximately equal to the sample volume or weight processed for sample analyses.

The purpose of the MB is to demonstrate that interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware, are known and minimized. A method blank should not contain target analytes at or above the reporting limit, unless otherwise permitted in the method. Other maximum blank contamination control criteria may apply, as indicated in the associated LIMS program specification.

While some methods may require background correction, sample results are typically not corrected for blank contamination.

14.9.5 Laboratory Control Sample

A Laboratory Control Sample (LCS) consists of an aliquot of well-characterized, controlled, certified matrix (e.g., reagent water, sand, solid reference material, Teflon™ chips) that is spiked with analytes of interest and processed through the sample preparation, cleanup, and analysis procedure. For industrial hygiene testing the appropriate media is added.

The purpose of the LCS is to provide an estimate of bias based on recovery of the compounds from the clean, controlled matrix, and to demonstrate that the laboratory is performing the method within accepted guidelines without potential non-matrix interferences.

Where sample pretreatment is not required, such as with ion chromatography or gamma spectroscopy analysis, or the analysis of volatile organic compounds, the ICV standard or other appropriate control standard may be employed as the LCS.

An LCS for methods with extensive lists of analytes that may interfere with one another may include a limited number of analytes, but the analytes included must be representative of as many analytes as is practical.

Other client-specific QC requirements may be prescribed in the applicable LIMS program specification.

14.9.6 Matrix Spike/Matrix Spike Duplicate

A matrix spike (MS) or matrix spike duplicate (MSD) is a field sample to which known concentrations of target analytes are added before the sample is processed. The purpose of MS/MSD samples is to assess the performance of the method for a particular matrix and to provide information about the sample's homogeneity. Results of the MS/MSD samples are evaluated in relation to the method QC samples to determine the effect of the matrix in regards to accuracy and precision. Sample results are not corrected for MS/MSD excursions.

For some analyses, changing the composition of the sample in any way invalidates the analysis to be performed (e.g., hardness, alkalinity, pH). Therefore, an MS/MSD pair cannot be generated for these analyses. Normally, duplicate sample aliquots are analyzed in order to generate an estimate of the method's precision.

Other client-specific quality control requirements may be prescribed in the applicable LIMS program specification. The requirements set forth in the LIMS program specification supersede those stated in the method, SOP or Quality Assurance Manual.

Not applicable for industrial hygiene and ambient air testing.

14.9.7 Sample Duplicate

A sample duplicate (DUP) is a second representative portion of sample that is carried through the preparation, cleanup and analysis process. Results for the duplicate sample are compared to the initial sample analysis results as a means of evaluating precision. For organic analyses, the MS/MSDs fulfill this function. The degree of sample homogeneity directly impacts the integrity of the sample duplicate analysis.

Not applicable for industrial hygiene and ambient air testing.

Precision criteria for sample duplicate analyses are those prescribed in the reference method and/or SOP, unless otherwise superseded by client-specific requirements contained in the applicable LIMS program specification.

14.9.8 Surrogates

Surrogates are organic compounds that are similar to the target analytes, but are unlikely to be present in actual field samples. They are introduced into all field and QC samples in a batch prior to sample preparation, and provide an estimate of bias based on recovery of similar compounds, for a given extraction technique and analysis method combination. Sample results are not corrected for surrogate recoveries.

Acceptance criteria for surrogates are those prescribed in the reference method and/or SOP, unless otherwise superseded by client-specific requirements contained in the applicable LIMS program specification.

14.9.9 Chemical Yield Monitors or Isotopic Tracers

Chemical yield monitors are used in radiochemical analyses and provide information similar to the surrogate spikes discussed above. The primary difference between a chemical yield monitor and a surrogate is that sample results are corrected for chemical yield recoveries and not corrected for surrogate recoveries. A chemical yield monitor is a substance that has similar chemical characteristics as the parameter being measured. It is introduced into all field and QC samples in a batch during the preparation procedure. Chemical yield monitors provide information regarding the performance of a method on a sample-by-sample basis.

Chemical yield monitors are evaluated against established laboratory control limits. These ALS default control limits may be superseded by other quality control criteria specified in the applicable LIMS program specification.

14.10 CONTROL LIMITS

14.10.1 Control Limits

Control limits for each controlled analyte are calculated, and can be updated, using ALS's LIMS. The recovery values from all data processed within a specified date range are used to calculate the control limits and compile the control chart if needed.

The upper and lower control limits of the control chart are designated as the value equal to the average recovery plus or minus three times the standard deviation (i.e., 99% confidence interval). The upper and lower warning limits for the control chart are designated as the value equal to the average recovery plus or minus two times the standard deviation (i.e., 95% confidence interval).

Control limits are updated as needed (e.g., acquisition of a sufficient number of data points to establish meaningful control limits for a newly implemented method; if deemed appropriate as a result of a corrective action investigation; etc.).

Control Limits are reviewed quarterly for trends only and on an annual basis to determine changes to control limits, if any. NO changes are made to current control limits if no changes are detected in the following process.

Current recoveries are compared to current mean and standard deviation of the current control limits. Any changes greater than 10% of the mean and 25% of the standard deviation are evaluated by operations as candidates for updating control limits. The decision rests with operations as instructions on how to proceed are given to QA personnel.

The update requires the review by operations to determine why changes are warranted. The review is needed to assess why a method/analyte combination is experiencing change. This operational review has options but is not limited to the following:

- Operations can request an update of control limits for the method/analyte combination based on evaluation that process changes have improved to steady state.
- Operations can request that control limits not be updated in order to review the current procedure to determine what procedural changes have taken place.
- Operations can request an update based on a specific set of data that is known to be valid based on the procedure.
- Operations can request control limits be reset to method limits based on evaluation that a steady state has not been reached.
- Operations can request no changes because current limits adequately reflect the current uncertainties in method performance

All data for processing and decisions on updating are maintained by the QA department.

14.10.2 Outlier Rejection

For the generation of quality control data that monitor the laboratory's performance, it is essential to prevent spurious or erroneous data from being incorporated. It may be necessary to reject data as an outlier to prevent an adverse effect on the values being calculated.

14.10.3 Trend Evaluation

In addition to evaluating individual batch QC results against control limits, QC results from successive batches are also evaluated for possible trends. See section 16.2.

14.11 SECOND COLUMN OR SECOND DETECTOR CONFIRMATION

Second column or detector confirmation is performed for several GC methods. Whenever two dissimilar chromatography columns or two detectors of a different nature are available for a given method, the laboratory performs second column or second detector confirmation analysis to confirm the identity of target analytes in field samples. When second column analysis is performed for any chromatography technique, the following policies apply:

- Every attempt will be made to calibrate the second (confirmatory) column in the same manner as the quantitative (primary) column. The same initial and continuing calibration standards will be analyzed on the confirmation column in the same manner as the quantitation column. The purpose of this dual calibration requirement is to allow the possibility of reporting quantitative results from the confirmation column if interferences on the primary column prevent accurate target analyte quantitation.

- For chromatographic techniques, the determination of target analytes in a sample depends solely on peak retention times observed in both primary and secondary column chromatograms. If target analyte peaks are present at the proper retention times in both confirmation and quantitation column chromatograms at levels above the LOD, then ALS considers this analyte to be confirmed.

- In general, ALS reports a single value from the two columns based on client requirements. In the absence of client requirements ALS reports the higher value of the two columns.

If no interferences are present, and an analyte's value from either the primary or secondary column is greater than the reporting limit but between the MDL and the reporting limit on the other column, then ALS reports the higher value that is greater than the reporting limit for that analyte.

14.12 MANUAL RE-INTEGRATION POLICIES AND PROCEDURES

Many data collection systems allow the analyst to reprocess data, thereby allowing for the manual re-integration of analyte peaks. ALS makes every attempt to optimize peak integration parameters; however, manual reprocessing of data must be performed to correct a data system's integration errors (e.g., incorrect or missed peak assignment, over- or under-integration of area). Manual re-integrations may not be performed solely to meet initial or continuing calibration criteria or any QC criteria (e.g., tuning, or surrogate or spiking compound recovery).
Whenever a manual integration is performed, the analyst must follow manual integration procedures given in ALS SOP 939.

15 CONTROL OF NON-CONFORMING ENVIRONMENTAL TESTING WORK

15.1 ALS NONCONFORMANCE AND CORRECTIVE ACTION PROCESS

Non-conformances are reported (documented) electronically through a LIMS interface that is available to all staff. The individual who discovered the problem or deviation is responsible for initiating the next sequential NCR in LIMS. Note that in addition to documenting laboratory sample or test issues, NCRs are also used to address client inquiries and complaints.

As described in ALS SOP 928, the processing of the NCR flows from the initiator, to their Group Leader and the relevant Project Manager(s), and finally to the Quality Assurance Manager. In this manner, an evaluation of significance and a decision on data recall, stop work and client contact can be made.

The Project Manager records any problem- related contact with clients in the NCR system.

The review of NCRs by the Quality Assurance Manager that are determined as a reoccurring systemic event or significantly against ALS policy or procedure will be addressed as a corrective action.

16 CORRECTIVE ACTION, PREVENTIVE ACTION, AND IMPROVEMENT

16.1 CORRECTIVE ACTION

Corrective actions are required for external audit findings, internal audit findings and when NCR requires corrective action as stated above.

16.1.1 Corrective Action Definition

A corrective action used to eliminate systematic and reoccurring events. Corrective actions include a determination of cause, selection of appropriate corrective actions, and monitoring to ensure effectiveness. Corrective actions are required for nonconforming events discovered during internal and external audits or when NCR is reoccurring or against ALS Policies and Procedure.

16.1.2 Root Cause

Root cause is a process to determine the cause of an error. Proper root cause analysis is the key to a successful process and sometimes the most difficult part in the corrective action procedure. Often the root cause is not obvious and thus a careful analysis of all potential causes of the problem is required. The root cause process followed must reflect the severity of the problem identified.

16.1.3 Documentation

All corrective actions require written documentation of events, root cause, immediate and permanent corrective actions. When corrective actions are applied there must be monitoring for effectiveness. Quality Assurance keeps maintains a database of all corrective actions.

16.2 PREVENTIVE ACTIONS

ALS defines preventive actions as any event that will eliminate real and potential nonconformance.

ALS maintains service contracts (preventive maintenance, repair) for most major analytical equipment. ALS performs preventive maintenance on current equipment on an ongoing basis and these events are recorded in maintenance logs.

Preventive Actions using instrument performance or QC sample trending, although not required, is encouraged by analysts to help prevent noncompliant QC situations from occurring.

While a trend is not necessarily an out-of-control situation in itself, it can provide an early warning of a condition that can cause the system to go out of control. Trending can be used for calibration, equipment, reagents, and various other routine processes in the laboratory. ALS analytical SOPs describe in detail the assessment of batch and sample QC data in the laboratory.

The following conditions are trends that can initiate action and/or monitoring.

- A series of seven successive points on the same side of the mean
- A series of five successive points going in the same direction
- A cyclical pattern of QC sample results
- Two successive points between warning limits and control limits

ALS relies on analytical staff to identify trends in analytical systems and processes. Quality Assurance and laboratory personnel can produce control charts as needed to help assess trends but this activity in itself is not preventive and is only used to verify trends exist. The occurrence of a trend does not invalidate data that are otherwise in control. However, trends do require attention to determine whether a cause can be assigned to the trend so that appropriate preventive action can be undertaken.

Long term trends in control limits are evaluated yearly by Quality Assurance as per section 14.10 and technical operations as described below on an ongoing basis.

16.2.1 Process for identification of trends in QC data

Control limits are guides used for data evaluation. Verifying that QC sample values are not trending ensures that the method may continue to be used for the analysis of field samples. If an undesirable trend appears in the analytical QC data, field sample data for samples analyzed with the QC samples might also be trending in the same manner.

A trend in method QC data might be indicated if one or more of the following situations exist:

- A series of seven successive points on the same side of the mean
- A series of five successive points trending in the same direction
- Two consecutive points outside of warning limits

To identify a trend in surrogate, tracer and carrier recovery data, all values for a preparation batch must be evaluated collectively as a

single event, since the values were generated during the same preparation event. Trends should be evaluated between preparation batches and not on any single sample.

LIMS can provide control charts for review to verify that trends exist but is not a tool used for trend identification. It is the responsibility of the analyst to review data for trends.

16.2.2 Evaluation of Significance

After a trend has been identified, the significance of the trend must be evaluated. An individual trend in data might, or might not, be a cause for action, particularly in the case of a single analyte in a multi-analyte method.

Examples:

1) Seven points (values of 97% – 100%) on the same side of the chart mean (value of 96%), with a warning limit at 104% and a control limit at 109%.
Evaluation: Consistent data, less than one standard deviation from the chart mean. No action required.

2) Five successive points (values of 88% – 96%) moving in the same direction, with a chart mean of 94% and an upper control limit of 109%.
Evaluation: Data moving across the chart mean, within one standard deviation from the chart mean, data are in the middle of the performance range of the method. No action required.

3) Five successive points (values of 94% – 107%) moving in the same direction, with a chart mean of 94% and an upper control limit of 109%.
Evaluation: Data moving away from the chart mean, nearing the control limit. Action while not required should be implemented to keep the procedure from going out-of-control.

If data exhibit a sufficiently significant trend to require action, the cause of the trend must be determined.

Questions to be considered in the evaluation of a data trend and the determination of the cause of the trend might include (but are not limited to) the following:

<u>Five Why Root Cause Analysis</u>

- Is this trend representative of the entire method?

- Is this trend limited to a single analyte in a multi-analyte method?
- Is this trend exhibited in the data of several analytes in a multi-analyte method, and is the same general trend observed for each analyte?
- What is the time period of the trend (i.e., a week, several weeks, several months)?
- What changes in the analytical system have occurred during the time period to which the trend applies?
- Are new personnel involved?
- Is different instrumentation involved?
- Were new or different standard solutions introduced?
- Was there a change in the analytical protocol or method?
- Has instrument sensitivity or response changed dramatically?
- Has instrument maintenance been performed recently?
- Have there been any changes in method reagents (i.e., brand, lot)?
- Have there been any matrix effects carried over from difficult samples?

16.2.3 Assignment of Significance

Following the identification of a data trend (as indicated above) and the evaluation of the trend for significance, a decision must be made that the level of significance does or does not require action.

At the time of quality control sample data evaluation, the evaluator must make a decision based upon personal judgment. Criteria can determine whether a trend exists, but judgment must be used in the determination of the significance of that trend.

If the data trend is determined to not pose a threat to the quality of immediate and future analytical data, or does not reasonably indicate that the analytical method might begin to produce data that could be anomalous, the level of significance is INSIGNIFICANT.

If the data trend is determined to not pose a threat to the quality of immediate analytical data such that no action is required, but does possibly indicate that the analytical method may begin to produce data that could be anomalous, the level of significance should be MONITORED by technical personnel.

If the data trend is determined to possibly or reasonably pose a threat to the quality of future analytical data, and reasonably indicates that the analytical method may begin to produce data that could be anomalous, the level of significance is SIGNIFICANT, and actions must be initiated to prevent out of control events.

16.2.4 Resolution Procedure

Following identification of a trend and an assignment of a level of significance, future action regarding the trend must be determined. If a data trend is evaluated as significant, laboratory personnel responsible for data trend evaluation must promptly inform all analysts involved in work related to the significant trend that the trend exists and that action must be initiated to prevent its reoccurrence and correct it.

All activities related to a significant trend will be documented in normal analysis records.

Laboratory personnel are required to initiate action to correct a significant data trend related to their work.

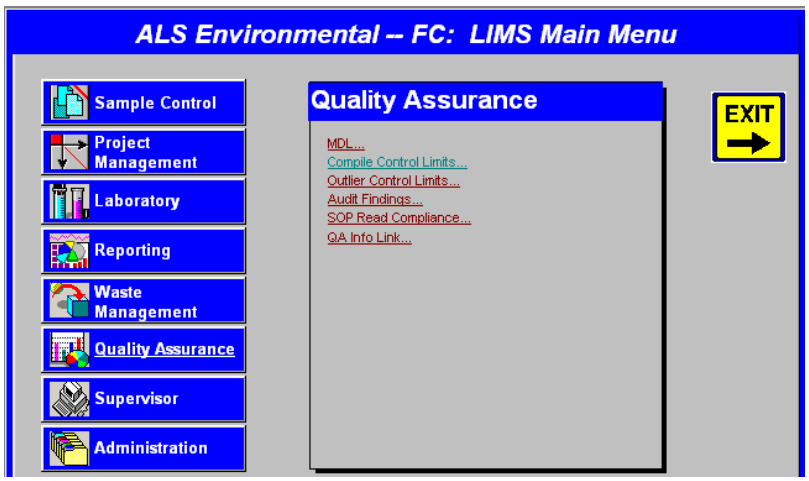
The trending rules used by ALS are in the following table. In most instances experience chemists identify trends and take action upon reviewing analytical data.

RULE	DESCRIPTION	POSSIBLE PREVENTIVE ACTIONS
Above Warning Limits	Two of three data points above warning limits	Check Calibration and Spiking Solutions Instrument Maintenance
Below Warning Limits	Two of three data points below warning limits.	Check Calibration and Spiking Solutions Instrument Maintenance
Above Mean	Seven consecutive data points above the mean	Check Calibration and Spiking Solutions Instrument Maintenance
Below Mean	Seven consecutive data points below the mean	Check Calibration and Spiking Solutions Instrument Maintenance
Ascending Data	Seven consecutive data points in ascending direction	Check Calibration and Spiking Solutions Instrument Maintenance
Descending Data	Seven consecutive data points in descending direction	Check Calibration and Spiking Solutions Instrument Maintenance

16.2.5 Procedure for producing Control Charts to verify trends are present

This procedure is available if verification of trends is needed.

- LIMS Main Menu
- From Quality Assurance Menu
- Select Compile Control Limits



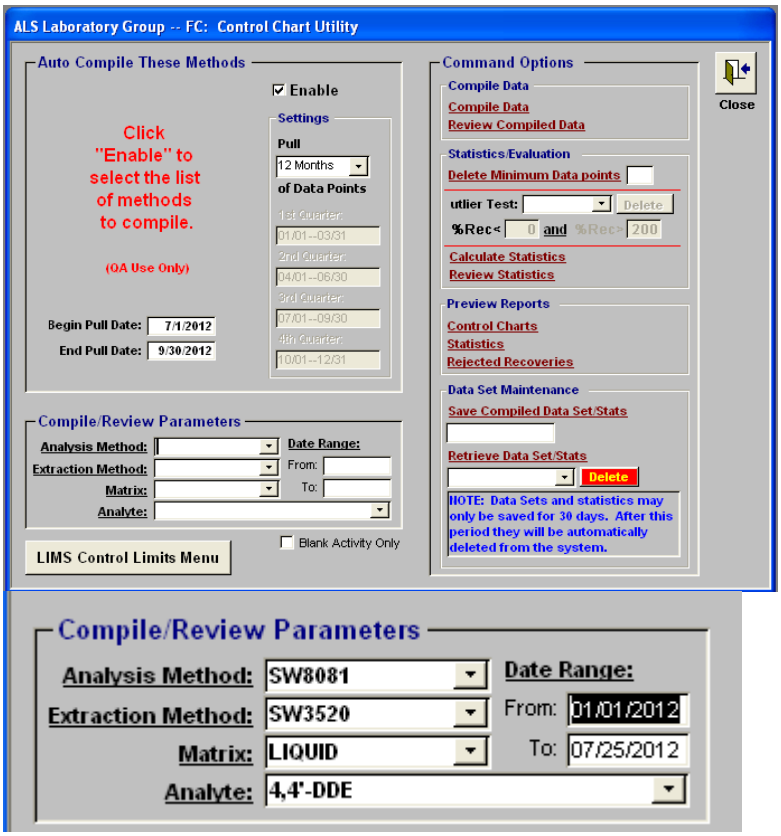
Compile Control Utility Menu

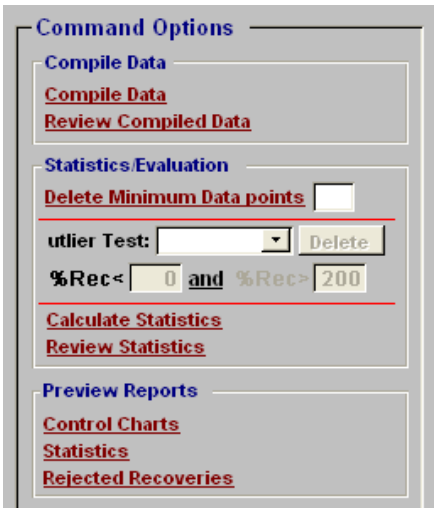
In the Compile/Review Parameters Box:

Select Analysis Method, Extraction Method, Matrix, Analyte and Date Range (Use no more than the last 12 months)

In the Command Option Box (In Sequence)

Compile Data
Calculate Statistics
Control Charts





16.3 IMPROVEMENT

At ALS, improvement of the quality systems is effected through an ongoing systems review by management using input from all staff.

ALS actively seeks employee and client input for improvements through surveys and questionnaires.

Internally ALS maintains a process improvement website and database for employees to provide suggestions for improvements and to record actions by managements.

For clients, ALS surveys and gains feedback on services provided. This input to management is managed at a corporate level.

17 CONTROL OF RECORDS

17.1 RECORDS AND DATA STORAGE

Records provide the direct evidence and support for the necessary technical interpretations, judgments, and discussion concerning laboratory results. These records, particularly those that are anticipated to be used as evidentiary data, provide the historical evidence needed for later review and evaluation. Records must be legible, identifiable, and retrievable. They must be protected against damage, deterioration, fire, theft, vermin, and loss. Though only 5-year retention is required by TNI, ALS retains all records for a minimum of seven (7) years, or as otherwise specified per the client's contract.
Laboratory records include the following kinds of documentation:

- personnel qualifications, experience, and training;
- correspondence between ALS and clients;
- quality assurance records (e.g., retired SOPs and Quality Assurance Manuals, PT study results, internal and external audit reports and responses);
- contents of laboratory logbooks;
- equipment maintenance records;
- traceability of standards, solvents and reagents;
- instrument checks and calibrations;
- raw data;
- final data reports; and
- sample management records (e.g., sample login, field and internal chain-of-custody, storage, disposal).

17.2 ELECTRONIC RECORDS

ALS employs a multi-level system that addresses both the frequent backup of sample results (in LIMS) and the periodic backup of raw data (from both networked and non-networked instruments). Additionally, the software that ALS uses for these backups, contains a disaster recovery module that allows

for the complete recovery of the backup database, in its entirety. See ALS SOPs 1403 and 1401 for additional information.

17.3 TRANSFER OF RECORDS

In the event that the laboratory changes ownership, the responsibility for the retention of records in accordance with the guidelines established in this Quality Assurance Manual, is conferred to the new owner. Should ALS go out of business, ALS will inform our clients in writing of this business decision, and that the transfer of records to the client must be in compliance with state, regulatory and legal records retention times.

17.4 TRAINING RECORDS

Technical and quality assurance training records are maintained on network servers by the Quality Assurance Department. Health & Safety training records are also maintained on network servers. Training records are designated for storage using the ALS SOP 150.

18 AUDITS

All non-conformances from internal and external audits require corrective action as per section 16.1.

18.1 INTERNAL AUDITS

Internal audits include both technical and systems audits, and are performed periodically per an annual schedule developed and maintained by the Quality Assurance Department.

All internal audits are conducted by QA staff or designees who, by experience, are deemed to be knowledgeable in the area assessed. Reports of nonconformance and opportunities for improvement are completed monthly by the Quality Assurance Manager.

See **ALS SOP 937** for additional information pertaining to internal audit procedures.

18.2 EXTERNAL AUDITS

External audits may be performed by a state or Federal agency or a client as part of an ongoing certification or client process. Items evaluated by external assessors may include, but are not limited to, reviews of the following: analytical capabilities and procedures; COC procedures; document control; quality systems; and QC procedures.

19 MANAGEMENT REVIEW

A Managerial Review is performed annually. The Managerial Review assesses operational effectiveness in terms of meeting ALS's business goals. It is a tool used to document and facilitate the consideration and introduction of needed operational changes and improvements.

The Managerial Review is performed the laboratory director. The contents of the annual Managerial Review are considered to be confidential.

Inputs to the Managerial Review may include, but are not limited to the following:

- suitability of policies and procedures;
- reports from managerial and supervisory personnel;
- outcome of recent internal audits;
- corrective and preventive actions;
- assessments by external bodies;
- results of interlaboratory comparisons or proficiency tests;
- changes in the volume and type of the work;
- customer feedback;
- complaints;
- recommendations for improvement;
- other relevant factors, such as quality control activities, resources and staff training.

The laboratory director is responsible for action plans that are documented in an annual summary report of all item listed in above. This summary report will include the actions initiated from management review and outcomes or effectiveness of previous actions.

20 PERSONNEL

The selection of well-qualified personnel is a factor that contributes to ALS's success. Therefore, qualifications of personnel are based upon education and experience. In order to maintain qualified staff, provide personnel advancement within the laboratory, and to provide for personnel's ongoing awareness of potential hazards and protective measures, ALS follows a program of orientation and training. Records of all training are maintained by the Quality Assurance Department in accordance with ALS SOP 150.

20.1 ORIENTATION

New employees receive a four-part orientation as described below:

- Human resources -- involves matters of immediate personal concern, such as benefits and company policies

- Quality assurance -- addresses topics related to ethical conduct, good laboratory practices and ongoing documentation of employee capability demonstrations. Required readings (SOPs, Quality Assurance Manual) are assigned at this time. See ALS SOP 143.

- Health & safety -- provides for a review of ALS's various safety program documents (Chemical Hygiene Plan, CHP; Radiation Protection Plan, RPP; Emergency and Contingency Plan, ECP; Respiratory Protection Plan, ResPP; Waste Management Plan, WMP); as well as other safety and security training such as the Alstar/Induction training.

- Department functional orientation -- focuses on the new employee's basic understanding of their role within the overall role of Operations within the structure of ALS. The department training expands upon the employee's scientific background and work experience to provide the employee with a level of competence that enables the individual to successfully function within the defined responsibilities of his/her position.

Temporary employees receive the same orientation as regular staff, with the exception of the human resources orientation.

20.2 TECHNICAL TRAINING

Chemists (analysts) and technicians are qualified to perform specific analytical procedures and methods. Technical management and quality management authorize employees to perform testing activities. The qualification process is detailed in the ALS SOP 329.

21 REPORTING OF RESULTS

21.1 DATA REDUCTION, VALIDATION AND REPORTING

Data transfer and reduction are essential functions in summarizing information to support conclusions. It is essential that these processes are performed accurately and are followed by multiple reviews before data are submitted to the client. All analytical data generated by ALS are extensively reviewed for accuracy and completeness. The data validation process consists of data generation, reduction, and multiple levels of review, as described below.

21.2 DOCUMENTATION OF RAW DATA

Where possible, raw data are captured and processed electronically using verified software programs (see ALS SOPs 709 and 1400 for further information regarding software verification).

To facilitate manual documentation of raw data (where suitable LIMS benchsheet interfaces do not yet exist), ALS creates custom logbooks as per ALS SOP 303.

The manually recorded raw data are entered into the laboratory logbook directly, promptly, and legibly in indelible ink. All raw data entries must be in compliance with ALS SOP 303.

Raw data not only includes instrument outputs, but sample preparation, standard materials documentation, and equipment maintenance information as well. Raw data is archived electronically.

21.3 CORRECTION OF ERRORS IN DOCUMENTS

During the course of processing and reviewing sample preparations and analysis results, it may be necessary to correct documentation errors. Detailed requirements for the correction of manual documentation errors are prescribed in **ALS SOP 303**

21.4 DATA REDUCTION

ALS analysts perform data reduction. This process consists of interpreting instrument results and verifying calculated concentrations in samples from the raw data. The complexity of the data reduction is dependent on the specific analytical method and the number of discrete operations involved in obtaining a measurement (e.g., digestions, dilutions, cleanups, concentrations). The analyst calculates the final reportable values from raw data or enters all necessary raw data into the LIMS so that the LIMS can calculate the final reportable values.

Data are reduced according to protocols described in SOPs and method-specific review checklists. Computer software used for data reduction is validated before use and verified regularly by manual calculations.

Copies of all raw data and the calculations used to generate the final results, as recorded in hardbound laboratory notebooks, spreadsheets, electronic data files and LIMS record files, are retained in the project file to allow reconstruction of the data reduction process.

21.5 REPORTING OF SAMPLE RESULTS

Sample results are reported either on an “as-received” basis, or in units of dry-weight measure. The number of significant figures reported is consistent with the limits of uncertainty inherent to the analytical method. In most cases, results are reported to no more than two or three significant figures. Analytical problems, and/or any modifications of referenced methods are noted in the data package case narrative.

21.6 DATA REVIEW

ALS employs multiple levels of data review. All data generated and reduced follow review protocols specified in laboratory ALS SOPs 052 and 715, method-specific checklists and the applicable SOPs.

Each step of the review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the analysis and/or review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data produced are consistently of known, documented, and appropriate quality.

21.7 PROCEDURES FOR HANDLING UNACCEPTABLE DATA

When an analysis of a QC sample (e.g., MB, LCS, CCV, etc.), indicates that the associated samples do not meet requirements, the analyst must immediately initiate a NCR as per ALS SOP 928.

If the non-compliant data cannot be corrected, then the affected results must be flagged as discussed below, and the discrepancy disclosed in the data package case narrative.

21.8 DATA REPORTING

Data reports contain final sample results, the methods of analysis used and limits of detection, and QC data. The extent of supportive data included (e.g., benchsheets, run logs, calibration data, instrument raw data printouts, etc.), is contingent upon the type of report contracted by the client. Results of subcontracted data are clearly indicated as subcontract laboratory results when incorporated into the final data package report. Data reporting is specified by project managers in the corresponding program specification in LIMS.

21.8.1 Facsimile or Imaged Reports

For projects that require rapid turnaround of sample analysis results, the laboratory may provide a facsimile or imaged e-mail attachment to the client, followed by the full data report at a later date. If the analysis results provided by facsimile or imaged e-mail attachment have undergone the same review processes followed for final data packages, then this forwarded report indicates that the sample analysis results are final. However, if the accelerated turnaround time requirements preclude a full review/validation of the sample data, then the report is marked as “PRELIMINARY” to indicate that results may change as the review process is completed.

21.8.2 Hardcopy Data Packages

The format and content of a data report is dependent upon project specifications, and it is beyond the scope of this document to describe project-specific report requirements. In the absence of client-specified data package deliverables, the following sections describe the items that must be included in all data reports.

21.8.2.1 Cover Letter

Items contained in the cover letter include:

- the client's name and address;
- ALS's name and address, name of contact and telephone number;
- a tabular presentation of field/client sample ID, ALS Sample ID, date received, matrix, and date collected. This item is typically presented as an attachment, the Sample Cross Reference Table;
- a list of each analysis performed and total number of pages for each analytical report;
- identification of all test data provided by a subcontract laboratory;
- a discussion of previously submitted or partial reports that pertain to the samples discussed in the current report; and
- the signature of ALS's Project Manager or designee.

21.8.2.2 Report Format

Analysis reports are presented in tabular format, and consistent significant figures and units of measurement are used. The following information is included in each report:

- laboratory name, client name, project name and/or number;
- client/field sample ID and ALS sample ID;
- date of sample receipt, date and time of sample collection, and date/time of sample preparation and/or analysis;
- sample matrix;
- reporting units and identification of whether the sample results are reported on an "as-received" or dry weight basis;
- method reference for the parameter analyzed and method reporting limits;

- identification of numerical results with values below the method reporting limit;
- case narrative that identifies test methods, describes any deviation from the method or contractual requirements, additions or exceptions to the SOP, and discloses any conditions that may affect the quality of the results;
- identification of sample results that did not meet sample acceptance criteria;
- footnotes or qualifiers referenced to specific data (as applicable) and explanations or keys to flags and abbreviations used;
- surrogate and tracer recoveries, where applicable;
- where applicable, a statement of the estimated uncertainty of the test result; and
- a signature and title, or equivalent electronic identification, of the personnel who accepts responsibility for the content of the report, and the date of issue.

Results calculated between the MDL and the LOQ (RL) contains significant amounts of error. Therefore, values reported between the LOD and LOQ(RL) are qualified as estimated – 'J' flagged for organic parameters, 'B' flagged for inorganic parameters. Also, LOD values are based on an interference-free matrix, and cannot evaluate the effects of sample matrix. Therefore, established LODs may not be achievable in some environmental matrices.

If a report is reissued, the amendments must clearly state that the report is reissued. The cover letter and case narrative must describe why the report has been reissued and which sample results have been reissued.

21.8.2.3QC Reports

Each final report may include QC reports that summarize results from the associated LCS, MB, and matrix QC samples. Additional QC samples may be prepared and reported to comply with project-specific requirements.

21.8.2.4 Data Qualifiers – Flagging Codes

Whenever the data quality objectives of the Quality Assurance Manual are not met, the associated sample results must be flagged with the appropriate flagging codes.

Other flagging practices may be observed if so dictated by the applicable LIMS program specification.

21.8.3 Electronic Data Deliverables (EDDs)

The electronic data deliverables generated by the laboratory are project-specific and are produced in a format specified by the client. *Information presented in corresponding fields of the hardcopy report and EDD are identical as both are generated from LIMS.* Before submitting the EDD file, the Project Manager or designee verifies that the EDD is complete and meets the client's format requirements. All EDDs are submitted to the client on computer disks or are transmitted electronically.

21.9 CONFIDENTIALITY

All laboratory results and associated raw data are confidential and may not be released to or discussed with any party other than the client who requested the analytical services.

ALS requires that auditors honor our clients' and ALS's confidentiality requirements, and will not discuss any results, documents, or records viewed during the course of an audit.

Confidentiality is included as a component of ALS's ethics training, which is provided to each person as they join the ALS staff, and annually, as a refresher training, thereafter.

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Appendices are available upon request. All current documents are available on ALS On-Line. The documents listed in this section are dynamic; accordingly they can change without notice or revision to this QAM.

APPENDIX A – GLOSSARY, ACRONYMS AND SYMBOLS GLOSSARY

APPENDIX B – Organization Charts and Key Personnel Qualifications

APPENDIX C – Ethics and Data Integrity Policy

APPENDIX D – Laboratory Floor Plan

APPENDIX E – Analytical and Support Equipment

APPENDIX F – Containers, Preservation and Holding Times

APPENDIX G – Master List of Controlled Documents

APPENDIX H – Data Qualifiers

APPENDIX I – Laboratory Accreditations

APPENDIX J – Calibration and Method QC Requirements

APPENDIX K – Chain of Custody

APPENDIX L – List of Services

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Pages 683-1348 of the original document were deleted with Exemption 4 marked on them.

These pages were deleted with the approval of the requester as Adobe had issues with saving the redactions.

THOMAS HOLZFASTER

DS Environmental Consulting, Inc. – Inspector/Air Monitoring Specialist

EXPERTISE

Thomas has more than 10 years' experience in working on asbestos, radon, and mold abatement/remediation projects on residential, commercial, municipal, K-12, and university system projects. with 7+ years in soil specific projects. As a CABI, AMS, Mold specialist, and Radon and Lead tester, Thomas has acquired diverse knowledge in the environmental consulting field. With a broad clientele base ranging from individual home owners to private contractors and government agencies, Mr. Holzfaster has worked extensively on a variety of environmental contaminations and cleanup procedures.

PROJECT EXPERIENCE

Inspection and Air Monitoring, Water management support - St Anthony's hospital redevelopment and new construction.
Inspection, Soils testing, Air Monitoring, Sub-contractor oversight – Denver Federal Center – Downing Reservoir Project.
Inspection and Soils Testing - Fruita Refinery, CASI Remediation, UCD Anschutz, Auraria Campus, Former Gates Property
Inspection and oversight – Globeville Smelter redevelopment, Brighton Boulevard Infrastructure – City & County of Denver
Asbestos, Mold and Radon testing/abatement projects for Denver Public Schools, Denver Housing Authority properties, Auraria Higher Education Center, University of Denver, and multiple State of Colorado facilities.

MANAGERIAL EXPERIENCE

Mentoring and, training new inspectors in Building inspection, Passive Radon testing, Air monitoring processes, Soil inspection, contaminated site characterization and remediation.

During a 15-year career in Information Technology trained, and managed multiple teams in hardware and software deployment projects.

PROFESSIONAL EMPLOYMENT HISTORY

Industrial Hygienist/Remediation Oversight – DS Environmental, Denver, CO (11/2015 – Present)

Building Inspector/Air Monitoring Specialist – Environmental Technical Solutions LLC. Denver, CO (2009 – 2015)

Building Inspector/Air Monitoring Specialist – Schafer Environmental Consulting LLC. Lakewood CO (2008 – 2009)

EDUCATION

H.S. Diploma, Lakewood High School, Lakewood, CO – 1980

I.T.T. Technical Institute – 3/4/1994 – Associate Degree - Electronics Engineering Technology

PROFESSIONAL DEVELOPMENT/CONTINUING EDUCATION

Colorado Certified Asbestos Building Inspector (annually)
Colorado Certified Air Monitoring Specialist (annually)
Colorado Certified Lead-Based Paint Inspector (annually)
NIOSH 582 Phase Contrast Microscopy Analyst (2009 – current)
Occupational Safety Health Administration (OSHA) HAZWOPER 40-hour (2008)
Occupational Safety Health Administration (OSHA) HAZWOPER 8-hour (annually)
IHPAT-Round Proficient NIOSH Method 7400 Airborne Asbestos PCM Analyst (Quarterly)
Current GSA/Denver Federal Center Security Clearance Badge
Current University Colorado Denver/ Anschutz Medical Campus Access Badge
Prior Security Clearance State of Colorado Badge / All facilities access code
Occupational Safety Health Administration 10-hour Construction Safety and Health
EPA RRP Lead Certification (2015 – 2020)
Certified X-Ray Fluorescence Lead-analyzer (XRF) – (2016)
OSHA 10-Hour Construction Industry Safety Training – 2010
OSHA Hazard Communications Training – 2002

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STEWART ENVIRONMENTAL
CONSULTING GROUP, LLC
ENGINEERING FOR LIFE

ACEC
MEMBER

Stormwater Management Plan
Drum Removal Project
Neuhauser Landfill

for

Stratus – Redtail Ranch LLC
County Road 5 and 6
Erie, Colorado

Prepared by

Stewart Environmental Consulting Group, LLC
Consulting Engineers and Scientists
Fort Collins, Colorado

December 2017

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Appendix D: Visual Monitoring Requirements

1.0 INTRODUCTION

1.1 Background and Purpose

In October 2017, Stratus Redtail Ranch, LLC (Stratus), retained Stewart Environmental Consulting Group, LLC (Stewart Environmental) to prepare a Stormwater Management Plan (SWMP) for the drum removal project at 1831 County Road 5, Erie Colorado (herein referred to as the Construction site). Stewart Environmental prepared this SWMP for Stratus and their contractor ACT Environmental and PSC Now (ACT/PSCN), the remediation contractor, to comply with guidelines of the Colorado Department of Public Health and Environment's (CDPHE's) Colorado Discharge Permit System (CDPS) Permit Number COR900000, General Permit for Stormwater Discharges Associated with Construction Activity (herein referred to as the General Permit). The EPA order for this project waives a site specific permit though the appropriate criteria of the general permit issued by the State of Colorado are to be met.

One of the requirements of the General Permit is the development of a SWMP, as described below in an excerpt from CDPHE's *Stormwater Management Plan Preparation Guidance (April 2011)*:

> *To regulate the amount of pollutants entering Colorado Waters, the Colorado Water Quality Control Act mandates that certain types of industrial activities that discharge stormwater to state waters (including discharges through storm sewer systems) must obtain coverage under a Colorado Discharge Permit System (CDPS) permit issued by the Colorado Water Quality Control Division (the Division). The Division developed the CDPS General Permit for Stormwater Discharges Associated with Non-Extractive Industrial Activity (Industrial Stormwater Permit) to provide the required permit coverage for those stormwater discharges associated with the industrial activities listed in Appendix A (Page 105) of the Industrial Stormwater Permit. All facilities that apply for the Industrial Stormwater Permit must develop a Stormwater Management Plan (SWMP).* In this project, we are not applying for a permit but we are developing this plan to comply with the AOC with the EPA.
>
> *Construction activity refers to ground surface disturbing activities, which include, but are not limited to, clearing, grading, excavation, demolition, installation of new or improved haul roads and access roads, staging areas, stockpiling of fill materials, and borrow areas. Construction does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the construction site. Stormwater Construction Permit coverage is required by State and Federal regulations for stormwater discharged from any construction activity that disturbs at least 1 acre of land (or is part of a larger common plan of development or sale that will disturb at least 1 acre).* This site was previously a landfill which then places this stormwater management plan in the light industrial section of the regulations. However, the current activity is a drum removal project and therefore, the focus of this stormwater management plan will be focused on that activity.
>
> *The Division developed the CDPS General Permit for Stormwater Discharges Associated with Construction Activity (Construction Activity Stormwater Permit) to provide the required permit coverage for those stormwater discharges associated with the construction activities listed in Appendix A of the Construction Activities Stormwater Permit.*

The information contained in this SWMP complies with the requirements of the CDPS General Permit COR900000 for Stormwater Discharges Associated with Construction Activity.

This project will employ stormwater controls to prevent runoff and sediment transport. In addition, the contractor will be employing spill control and prevention measures to prevent the accidental discharge of liquids or solids from the site.

1.2 Construction Activities

The State of Colorado identifies construction activities that require coverage under the General Permit based on the disturbance of 1 acre of land or greater. For construction projects, the Best Management Practices (BMP) will typically be utilized to control discharges. This is broken into three areas:

1. Erosion Control BMP's
    - Practices to prevent the erosion of soil at the project site.
2. Minimizing the amount of disturbed soil through phasing, temporary stabilization or leaving existing vegetation. Areas covered by test pit excavation will be covered with hay/straw to minimize erosion.
3. Sediment Control BMP's
    - Stormwater will be controlled with earthen berms, wattles and hay bales as needed to divert stormwater from work areas and minimize runoff and sediment migration.
    - Retaining stormwater in ponds or behind silt fence is part of the BMP for this site. The ponds will be constructed to prevent stormwater migrating from the work areas. This is classified as a "Class 1" temporary basin. The catchment area will be the work area for the drum removal project. Any potential run-on to the work area will be diverted to existing drainages and ponds at the site. ACT/PSCN will construct the work area ponds as necessary to contain work area runoff.
    - The pond is designed per the Urban Drainage and Flood Control District BMP practices. The estimated volume of the pond is 12,000 cubic feet. This will retain the volume of the work area for a 20-year storm event. This will be verified following installation of diversion berms and fencing and surveyed locations.
    - The stormwater will pass through a filter fabric or straw bales before the inlets to the stormwater ponds. The details of the filter fabric and the straw bales are provided in Figure 2.
    - The work area will also utilize run-on controls to prevent stormwater from entering the work area. This information is provided in Figure 2 of this plan. The run-on controls will be placed entirely around the work area.
4. Spill Prevention and Control
    - The contractor will be removing solvent and/or drums during this construction project. As part of this project, only 1 drum at a time will be handled to control the quantity of material that could be spilled.
    - All drums with waste material will be placed into overpack drums or the solvent contents will be moved to new UN approved drums for subsequent loading, transport and disposal.
    - The contractor will have emergency spill prevention control materials, such as solvent pigs, to make sure that the material does not leave the work area

1.3 SWMP Administrator

The SWMP Administrator is the contact for all SWMP-related issues, and the person responsible for development of the plan and oversight of the implementation, maintenance, and modification of the SWMP. Stratus identified Dr. David Stewart, as the SWMP Administrator. As the SWMP Administrator, he will conduct and document stormwater-related site inspections, review and revise the SWMP as needed, and observe the site for good housekeeping activities to assist in the prevention of stormwater pollution.

Daily inspections, as specified in Section 7, will be performed by ACT/PSCN, the Contractor on this project and any deficiencies will be reported to the SWMP Administrator for inspection and plan revision as necessary. Implementation, maintenance and field modifications will be completed by ACT/PSCN.

2.0 CONSTRUCTION SITE DESCRIPTION

2.1 Industrial Activities Conducted on Site

Activities at the site include the removal of liquid solvent the associated drums and surrounding soils and an area of sludge near MW-2. Construction will be primarily conducted within previously noted bermed work areas or other secondary containment work areas.

2.2 Construction Site Layout

2.2.1 Site Location and Description

The Construction site is located at 1831 County Road 5, Erie, Colorado. Figure 2-1 provides a map of the work areas proposed for this project.

2.2.2 Physical Setting

The Construction site is near the western edge of the Colorado Piedmont, which separates the Front Range of the Southern Rocky Mountains to the west from the High Plains to the east. Gently down warped sedimentary rocks of the Denver Basin underlay the Colorado Piedmont. Site topography has a slight gradient generally toward the west. There are several ponds at the site, located outside of the work area, which capture stormwater. The work areas will be bermed to divert stormwater from the work areas to the existing ponds. The closest waterway is Coal Creek to the northwest of the site. The stormwater from the work area will be collected in a controlled containment with subsequent testing and proper disposal as required by the RCRA regulations.

Climate in the site vicinity is typical of the Colorado Front Range and steppe environment with extremes of heat and cold in the summer and winter, respectively. Low annual precipitation and winds are characteristic of this semi-desert environment. Historical Climate Information available on The Western Regional Climate Center website shows the following information for Loveland for the Period of January 1, 1893 to September 30, 2010**:**

Average annual maximum temperature (degrees Fahrenheit): 62.2
Average annual minimum temperature (degrees Fahrenheit): 34.0
Average annual total precipitation (inches): 15.09
Average annual total snowfall (inches): 47.3

2.2.3 Adjoining Properties and Site Vicinity

- The east, west and north boundaries are owned by Waste Connections and have active landfill operations.
- The southern boundary of the work area is owned by Stratus Redtail Ranch, LLC.
- The western and southern sides of the Stratus property also contain active oil well operations.

3.0 CONSTRUCTION SITE MAPS

The Site Map includes a 2017 Google earth photograph as well as overall maps and details for the stormwater plan at the site. These are found in Figures 1 to 4 in the Figures portion of the plan. The map provides the following required information:

1. The surface water body's name and location that receives the Construction site's discharges, if they occur: **Coal Creek; see Google earth aerial photograph** – Figure 1
2. Stormwater significant impervious surfaces: **Not applicable – there are not any impervious surfaces on this site**
3. Stormwater conveyances: **The only stormwater conveyance is through the natural drainages shown on Figure 2. The contractor will control site run on and run off. The details of this surface flow and subsequent stormwater control BMP's are provided in Figure 2 through 4 of this report. The intent is to follow the Denver Urban Drainage and Flood Control District guidelines for construction of a temporary detention at the site. This may include as necessary soil berm diversions, silt fence, straw bales, wattles, etc.**
4. Directions of stormwater flow indicated by arrows. **Surface stormwater flow is depicted by contours on Figure 2.**
5. Areas where construction activities are conducted and where such activities are exposed to precipitation. **Include: drum removal area, staging areas, roads, excavation areas and soil borrow areas.**
6. Locations of all pollutant sources (actual or potential) associated with construction activity. **Includes chemicals and soils within secondary containment, excavation areas, staging areas, and load out areas on the site. All drum liquid removal, movement and overpacking will be performed one drum at a time. Spill containment measures will be on site and close to the work area to contain any chemical spills.**
7. Locations of all structural and applicable non-structural control measures used to meet effluent limits required by the permit. **See Figure 2 through 4. The contractor may modify the general BMP's in Figures 2 through 4 as needed to provide proper control of run-on and run-off from the drum removal work area. The SWMP will be updated upon final installation of surveyed control measures and BMP's.**
8. Locations of all stormwater monitoring points applicable to the construction site (visual, benchmark, numeric effluent, and water quality-based monitoring): **No discharge points from the drum removal work area are planned.**
9. Location and description of any authorized non-stormwater discharges: **None known.**
10. Locations and sources of run-on to the construction site from adjacent property that contains significant quantities of pollutants**: None known.**

4.0 CONSTRUCTION SITE INVENTORY AND ASSESSMENT OF POLLUTANT SOURCES

The inventory shall identify all area**s** associated with construction activities that have been, or may potentially be, sources of pollutants that contribute, or have the potential to contribute, any pollutants to stormwater, including but not limited to the following:

1. Outdoor processing area and drum removal is identified on the drainage map in Figure 1.
2. Outdoor storage of materials or products, including solids and liquids. All liquids are within secondary containment that will retain the 20 year storm. All contaminated soils will be within secondary containment and will retain the 20 year storm.
3. Loading and unloading of materials, including solids and liquids, will be within the staging area as identified on the map.
4. On-site dust or particulate generating processes, including dust collection devices and vents will be done on site per the contractor dust control plan.
5. Vehicle and equipment fueling, maintenance, and/or cleaning (includes washing) will be performed on this site.
6. Immediate access roads traveled by carriers of drums, waste soil, waste material created by the construction project.

4.1 Outdoor Processing Activities

Potential Pollutant Source: Medium

Stormwater will come in contact with this material but it will be retained within the stormwater detention in the work area. Therefore, no stormwater that comes in contact with this material will leave the site. Any stormwater that is collected in the work area detention basin will be tested for water quality criteria. This would include the CDPHE Solid Waste Appendix IA and IB, plus Appendix II for assessment monitoring. If necessary, based on testing criteria, the stormwater will be collected and disposed of at an offsite facility with prior approval of the regulatory agencies.

4.2 Outdoor Materials Storage

Potential Pollutant Source: Low to None

Material storages are within a container system (i.e. the overpack drums or the new UN drums) or within secondary containment for protection during a precipitation event.

Transport trucks will remain outside of the secondary containment and bermed areas of the drum removal work area, to avoid stormwater impacted by the work area.

4.3 Material Loading/Unloading and Material Transfer Operations

4.3.1 Material Loading /Unloading

Potential Pollutant Source: Low

Construction activity material loading and unloading is conducted at the area located as indicated on the drawing in Figure 2. In general, trucks will stay outside of the bermed area and all loading/unloading will be transferred over the berms, such as the overpack drums and/or the new UN approved drums containing the waste liquid or contaminated soils. If a storm event is occurring, no loading and unloading will occur. All excavated areas will be closed to prevent contamination from leaving the site. The intent is to keep the trucks away from the contaminated area to eliminate the need for decontamination of the trucks.

Should a drum or other container release occur during loading/unloading, a stormwater impact is unlikely. If the spill occurred within the truck, it could be contained there with a spill kit. If the spill occurred on the loading area, it could be contained there. In the unlikely event that a spill escapes the truck , such a release would enter the containment area.

It is unlikely that a potential impact to stormwater from on-site loading/unloading.

4.3.2 Material Transfer Operations

Potential Pollutant Source: Low

The drums will be placed into overpack drums on site or will be new UN approved drums and stored within the secondary containment area, therefore, the material is not transferred as part of the removal process off site. All material transferred off-site will be within secondary containment until loaded on the DOT approved trucks for transportation to the TSDF. There is very low potential impact to stormwater from on-site material transfer operations. All material transfer operations will cease during a storm event.

4.4 On-site Waste Treatment, Storage, or Disposal

4.4.1 On-site Waste Treatment or Disposal

Potential Pollutant Source: Low

There is not any onsite waste treatment or disposal on this site. Therefore, there is no potential impact to stormwater from on-site waste treatment or on-site waste disposal.

4.4.2 On-site Waste Storage

Potential Pollutant Source: Low

There is no outdoor storage of drums or containers outside of the secondary containment.

There is no reasonable potential impact to stormwater from on-site waste storage.

4.5 Waste Disposal Practices

Potential Pollutant Source: Low

4.5.1 Nonhazardous Waste

Sealed drums of nonhazardous, unregulated cleanup material may be temporarily stored within containers at the site awaiting pickup for off-site disposal by third party licensed disposal contractors.

Dumpsters and rolloffs are designated for nonhazardous waste disposal and are serviced by third party licensed disposal contractors.

There is a low potential impact to stormwater from on-site nonhazardous waste.

4.5.2 Regulated/Hazardous Waste

The site will have Resource Conservation and Recovery Act (RCRA) wastes which will be disposed of offsite. These will be removed in the specified work area and then stored in the specified storage area until shipment off site occurs. This will comply with the RCRA regulations as applicable. In addition, drum removal will be conducted one drum at a time, thereby reducing the risk of a release to the stormwater. Spill containment kits will also be present at the site, which will minimize this risk of releases to stormwater.

There is a low potential impact to stormwater from on-site waste disposal practices.

4.6 Vehicle and Equipment fueling, maintenance, and/or cleaning

Potential Pollutant Source: Low

The contractor does perform minor vehicle maintenance (fixing lights, etc.) and equipment fueling, maintenance and/or cleaning at the work area as needed.

There is low potential impact to stormwater from on-site vehicle and equipment maintenance and/or cleaning.

4.7 Aboveground Storage Tanks (ASTs)

This is not applicable to this site.

4.8 Off-site Polluant Sources

Potentiel Polluant Source: Low to None

There are not any adjacent construction activities up-gradient that will affect this site.

There is low to no potential impact to stormwater from off-site pollutant sources.

5.0 DESCRIPTION OF CONTROL MEASURES

5.1 Minimize Exposure

1. The construction site maintains all activities where there is low potential for contact with stormwater.
2. Waste material storage is in containment systems and within secondary containment.
3. There are not any chemicals that are stored at this site other than the RCRA waste and drums which will be within a container system and secondary containment until removed from the site.
4. Construction solid waste will be within a dumpster system and within the secondary containment.

5.2 Good Housekeeping

Checklist for the assessment of existing good housekeeping practices:

1. Are outside areas kept in a neat and orderly condition?
2. Is there evidence of drips or leaks from drum removal project or machinery at the site?
3. Is garbage removed regularly?
4. Are proper clean-up procedures used for spilled materials?
5. Is every effort made to order only materials that are required, thus minimizing the amounts of materials stored?

5.2.1 Operation and Maintenance Techniques

1. Garbage and waste materials must be picked up and disposed of regularly.
2. Signs are posted at appropriate locations indicating where to dispose of waste oils, used PPE materials, and refuse. Verification will be provided as part of the updated SWMP.
3. Locations where spill clean-up equipment and materials are stored are appropriately marked.
4. Pollution prevention concepts will be provided through training, posters, newsletters, mailings, workshops, etc.

5.2.2 Material Storage and Inventory

1. Storage containers, drums, and bags shall be stored away from direct traffic routes to prevent accidental spills.
2. General waste will be contained within roll offs on the site, if needed.

5.3 Maintenance of Control Measures

(See Appendix A of this SWMP for sample maintenance log.)

Maintaining all control measures in effective operating condition is essential and procedures must be clearly addressed in the SWMP to ensure sustainable implementation of preventive measures. Preventive maintenance ensures that structural control measures and industrial equipment are kept in good condition and help prevent or minimize leaks and other releases of pollutants.

- The construction stormwater process requires that PSC/ACT maintain all control measures used to achieve effluent limits required by the permit in effective operating condition. Control measures are inspected on a daily basis or as needed. ;
- Create and document a preventative maintenance schedule for industrial equipment and systems, control measures, and any backup practices.

5.4 Spill Prevention and Response Procedures

5.4.1 Potential Spill Scenarios

The most likely potential spill scenarios at the Construction site would occur in association with the following:

1. Chemical loading/unloading operations at the site in the shipping and receiving areas as noted on Figure 2.
2. Excavation to expose drums and the subsequent containment of the drum or transfer of the liquids to a new drum.
3. Contaminated soil loading/unloading as appropriate for the site.
4. It is possible that a flood event could occur at this site. If a precipitation event were to occur, the site would be closed and secured. Any exposed areas would be covered as necessary to prevent a stormwater discharge at the site.

5.4.2 Preventive Measures for Potential Spill Scenarios

1. All loading and unloading of materials in the shipping/receiving area shall be supervised by a trained ACT/PSCN member to ensure a quick response in the event of a spill.
2. All loading and unloading of drum material or contaminated soils will be performed within the secondary containment area.
3. Spill kits are stored near the locations on the construction site map and on the truck for loading/unloading.
4. The likely maximum spill from delivery of any solvent and chemical drums would be 55 gallons.

5. If a spill occurs during loading/unloading operations, it will be detained within the delivery vehicle, or on the off-loading area of the work area as indicated on the map.
6. Spill kits are placed at labeled locations in the shipping/receiving areas. During the offloading process, the supply trucker and a trained ACT/PSCN member observe the process. In the event of a spill, the spill kit will be utilized to prevent any of the chemicals from entering into the storm water drainage pattern.
7. If a spill occurs during transfer of materials, the nearest stormwater inlet will be blocked with sorbent berms to be used to dike the chemical. A vacuum truck or vacuum pump as applicable will be used to remove the spilled material. The sorbent berms will be removed only after inspection and verification that no chemical is present.
8. In the event of a spill, the source of the spill will be stopped immediately and contained. Spilled materials will be prevented from leaving the site by existing containment (curbs, berms, low areas) or by immediately absorbing or damming the spilled material to prevent migration. Spilled materials will not be washed or discharged into the stormwater drainage system or asanitary sewer system. Spill response equipment is available on site. All spills will be immediately reported to the OSC and the SWMP Administrator for appropriate notification to regulatory agencies. The SWMP Administrator will retain responsibility for chemical spill cleanup, materials testing, site testing, disposal, and reporting as may be required to satisfy regulatory requirements.
9. Transport personnel must be present at all times during loading/unloading.
10. Wheel chocks must be put into place before loading or unloading.
11. The transport vehicle must be visually inspected for leakage prior to departure from the Construction site.
12. In the event that a significant spill occurs, all required federal and local reporting government agencies will be notified, and corrective action will be taken to avoid a repeat of the incident. A release of any chemical, oil, petroleum product, sewage, etc., that may enter waters of the State of Colorado (which include surface water, groundwater, and dry gullies or storm sewers leading to surface water) must be reported to CDPHE and the City of Erie Stormwater Utilities; their contact information is listed below:

- **U.S. Environmental Protection Agency (EPA) (the EPA must be notified immediately of any incidents at the site).**
  Region 8
  999 18th Street, Suite 500
  Mail Code 8P2-W-GW
  Denver, Colorado 80202-2466
  (303) 312-6137 or (303) 312-6312 – OSC – Joyce Ackerman (303) 312-6822
  Regional Duty Officer – (303) 293-1788 (to be contacted if OSC cannot be contacted)
- **CDPHE**
  Water Quality Control Division
  Permits and Enforcement Section
  Mail Code WQCD-PE-B2
  4300 Cherry Creek Drive South
  Denver, Colorado 80222-1530
  (303) 692-3500 or (303) 692-3502

- **Town of Erie**
  Water/Wastewater Utilities
  Erie, Colorado 80516
  (303) 926-2700

5.5 Erosion and Sediment Controls

The construction site is undeveloped with expansive areas of vegetated ground. Eroded soil is prevented from entering the Construction site from off-site sources by topography and the presence of diversionary structures.

5.6 Employee Training

Stormwater training is required for all ACT/PSCN employees who work in areas where construction activities or material handling activities are exposed to stormwater, or who are responsible for implementing activities necessary to meet the conditions of the SWMP. This would include all levels of employees involved in operations and maintenance. New or temporary employees and contractors working at the Construction site also must be trained in the SWMP procedures as soon as possible. Contractors should be provided with a copy, as well as be informed that they are also liable for conditions set forth within the SWMP. At a minimum, the following employees must be trained:

- Those that oversee the implementation of, revising, and amending the SWMP;
- Those performing installation, inspection, maintenance, and repair of control measures;
- Those that work in areas of industrial activity subject to this permit; and
- Those that conduct stormwater discharge monitoring.

6.0 ADDITIONAL CONTROL MEASURE REQUIREMENTS

Not Used

7.0 INSPECTION PROCEDURES AND DOCUMENTATION

7.1 Inspection Frequency and Personnel

a. The permittee shall conduct and document visual inspections of the work area daily. Appendix C provides an inspection form.

b. Construction site inspection during a storm event. ACT/PSCN will provide an inspection during any precipitation event or within 24 hours after the end of, a measurable storm event which is a rain or snow melt event that results in a stormwater discharge from the construction site.

c. Visual Inspection during a storm event. One inspection must be conducted during a storm event. For this inspection, you must make observations of the stormwater runoff in order to qualitatively assess the nature of the discharge based on several visual parameters (floating

materials, visible oil sheen, discoloration, turbidity, odor, etc.). You must also look for the presence of illicit discharges and run-on from adjacent lands or facilities.

7.2 Inspection Scope

Each inspection shall include:

a. Observations made at stormwater monitoring locations and areas where stormwater associated with industrial activity is discharged off-site; or discharged to waters of the state, or to a storm sewer system that drains to waters of the state.

b. Observations for the presence of floating materials, visible oil sheen, discoloration, turbidity, odor, etc. in the stormwater discharge(s).

c. Observations of the condition of and around stormwater drainage ways.

d. Observations for the presence of illicit discharges or other non-permitted discharges such as domestic wastewater, noncontact cooling water, or process wastewater (including leachate).

e. A verification that the descriptions of potential pollutant sources required under this permit is accurate.

f. A verification that the Construction site Map in the SWMP reflects current conditions and updated as necessary.

g. An assessment of all control measures used to comply with the effluent limits contained in this permit, noting all of the following:

   i) Effectiveness of control measures inspected.

   ii) Locations of control measures that need maintenance or repair.

   iii) Reason maintenance or repair is needed and a schedule for maintenance or repair.

   iv) Locations where additional or different control measures are needed and the rationale for the additional or different control measures.

7.3 Inspection Documentation

a. ACT/PSCN shall document procedures for performing the inspections required. Procedures must identify:

   i) Person(s) or positions of person(s) responsible for inspection;

   ii) Schedules for conducting inspections, including tentative schedule for facilities in climates with irregular stormwater runoff discharges; and

   iii) Specific items to be covered by the inspection, including inspection schedules for specific outfalls. Also, the following are to be documented:

      - Inspection date and time
      - Locations inspected
      - Weather information and a description of any discharges occurring at the time of inspection

- A statement that the site is either in compliance or out of compliance with the terms and conditions of this permit
- A summary report and a schedule of implementation of the corrective actions that the permittee has taken or plans to take if the site inspection indicates that the site is out of compliance
- Name, title, and signature of the person conducting site inspection; and the following "I certify that this report is true, accurate, and complete to the best of my knowledge and belief"
- Certification and signature of the permittee
- ACT/PSCN shall maintain inspection documentation with the SWMP as required

8.0 CORRECTIVE ACTION DOCUMENTATION

Corrective action entails the review and revision of the selection, design, installation, and implementation of work area control measures to improve conditions at the construction site. ACT/PSCN must take corrective action if any of the following occur at the Construction site:

1. An unauthorized release or discharge (e.g., spill, leak, or discharge of non-stormwater not authorized by this or another permit).
2. In the event of a precipitation event, which causes a discharge from the construction site, a discharge sample will be obtained. A report and corrective action, if any, will need to be filed.
3. It the construction site control measures for the storm event are not stringent enough for the discharge to meet applicable water quality standards.
4. ACT/PSCN finds in a construction site inspection that the construction site control measures are not properly selected, designed, installed, operated, or maintained.
5. Construction or a change in design, operation, or maintenance at the construction site significantly changes the nature of pollutants discharge in stormwater from the site, or significantly increases the quantity of pollutants discharged.

If a corrective action is required, **it is essential that ACT/PSCN refer to the CDPS General Permit Guidelines** to ensure all required actions, documentation as above, and reporting occur along with notification to the OSC immediately. **All corrective actions taken by ACT/PSCN must be documented and kept with the SWMP.**

9.0 REPORTING AND RECORDKEEPING

A copy of the SWMP will be maintained at the construction site and readily available to personnel and/or regulatory agencies. ACT/PSCN shall retain copies of the SWMP, including any modifications made during the term of this permit, documentation related to corrective actions taken, all reports and certifications required by this plan, monitoring data, and records of all data used to complete the application to be covered by this plan.

The following shall be maintained with this SWMP:

1. SWMP records and any modifications made during the term of the construction site, and any letters received from the State of Colorado

2. Inspection records, including all construction site inspection reports, and visual assessment reports
3. Original sampling records, including field notes and laboratory reports
4. Employee training records
5. Maintenance and repair of Control Measures documentation
6. Corrective action reports

10.0 IMPLEMENTATION/COMPLIANCE

ACT/PSCN will implement and comply with the plan. Items that need to be completed are as follows:

1. Training.
2. Construction site inspection.
3. Stormwater visual monitoring.
4. Recordkeeping.

11.0 LIMITATIONS

Stewart Environmental prepared this SWMP for the exclusive use of Stratus and ACT/PSCN. Stewart Environmental does not authorize the use of this report and information contained herein, in whole or in part, by others without our and FRRM's written mutual consent.

Stewart Environmental prepared this SWMP in accordance with CDPHE's guidance document, *Stormwater Management Plan Preparation Guidance (April 2011)*, and the generally accepted practices of the profession under similar circumstances and conditions.

We based the contents of this plan strictly upon field observations, information provided by persons interviewed, and information contained in records pertaining to the construction site at the time of our plan development. Stewart Environmental makes no representations as to the condition of the construction site subsequent to the time of its investigation.

Stewart Environmental used reasonable diligence and its professional judgment consistent with industry standards to evaluate potential sources of contamination to stormwater discharged from the construction site. However, due to economic and physical constraints, an investigation of this type cannot reveal all potential sources of contamination. Therefore, Stewart Environmental cannot be held accountable for conditions or information that remained unknown at the time this SWMP was created. In addition, nothing in this report should be construed as a legal opinion. If legal advice is required, an attorney-at-law should be consulted.

12.0 ASSESSOR'S QUALIFICATIONS

Stewart Environmental has performed environmental consulting services for more than 4,700 different clients since 1980. With a staff of professional engineers, scientists, and technicians, Stewart Environmental is qualified to

prepare stormwater management plans. The following is a list of key Stewart Environmental personnel and their responsibilities on this project:

- David R. Stewart, PhD, PE – President of Stewart Environmental

Dr. Stewart (PhD – Environmental Engineering) provided overall project administration; performed the records reviews, site reconnaissance, interviews, and governmental official contacts; and prepared the SWMP document.

Environmental Professional Statement

We declare, that to the best of our professional knowledge and belief, we meet the definition of Environmental Professional as defined in §312.10 of 40 CFR 312; and we have the specific qualifications based on education, training, and experience to prepare stormwater management plans.

This plan was prepared by:

_____

David R. Stewart, PhD, PE
President

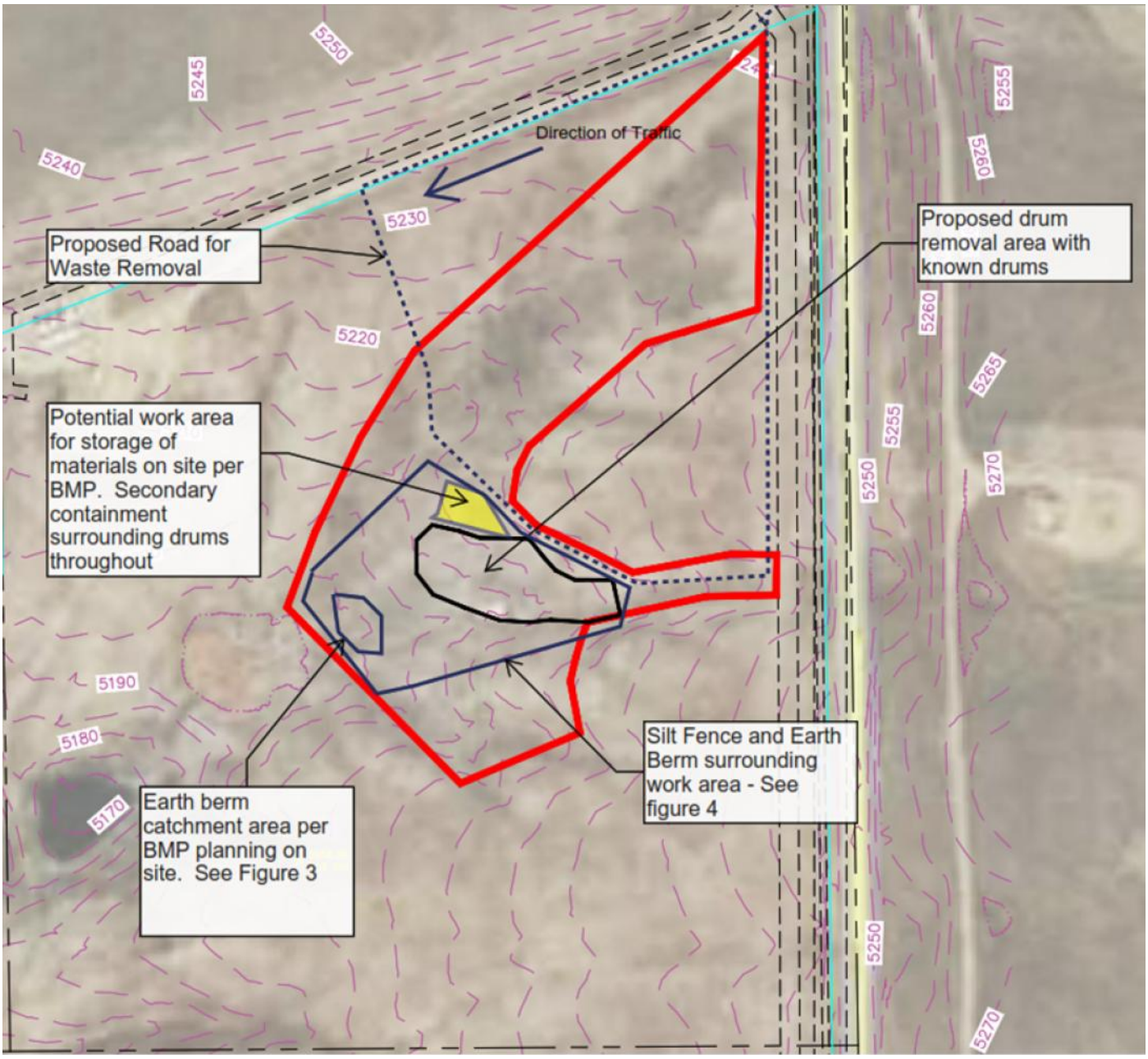
PE Certification Seal
November 16, 2017

Figures

Construction site Maps

STEWART ENVIRONMENTAL CONSULTING GROUP, LLC ENGINEERING FOR LIFE	PROPERTY LOCATION East Work Area- Stormwater Management Plan Area Map and Site Location	Figure 1
PROJECT NUMBER 4844-001 / DATE November 2017		

wp files\4263.001\figure 1 - site location.cdr



North
NTS

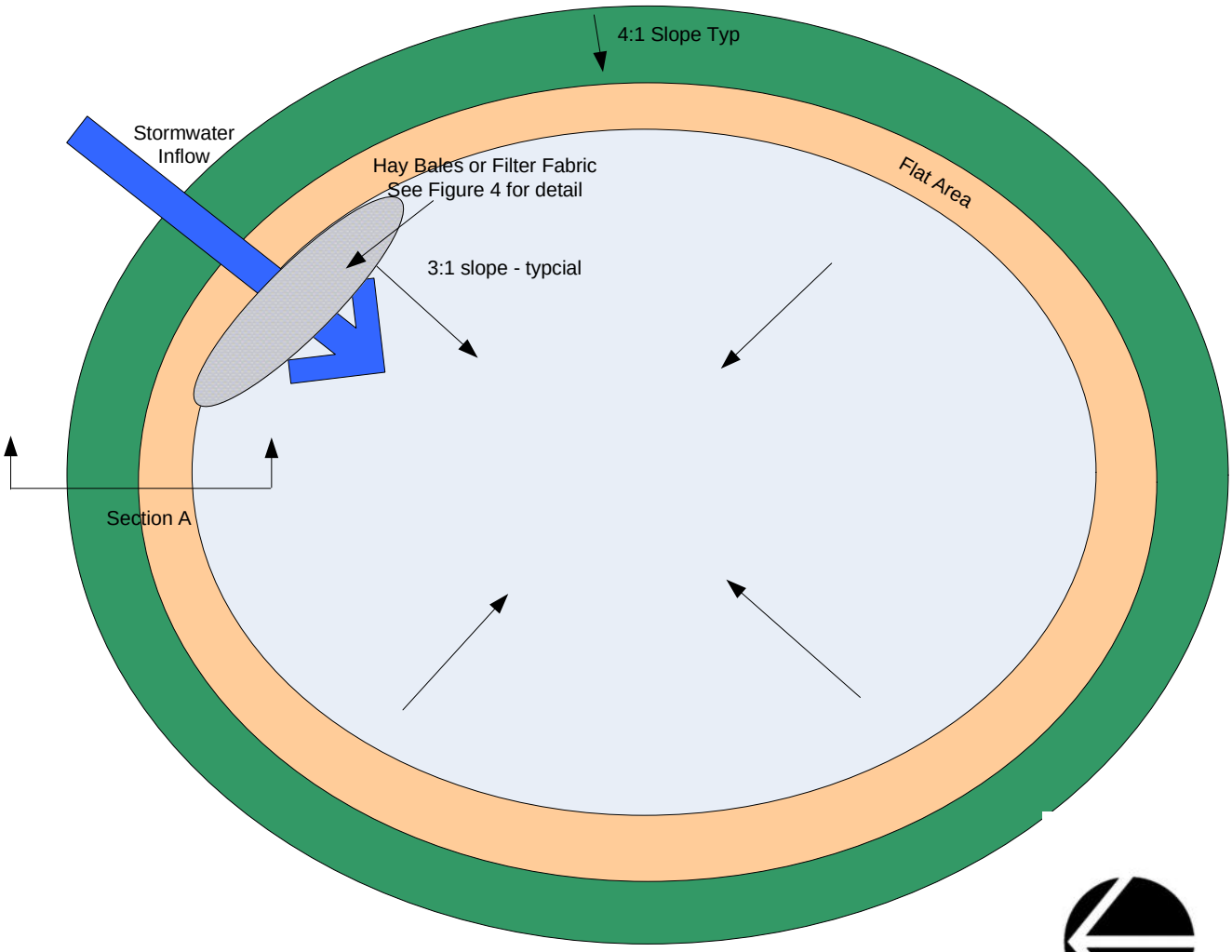
STEWART ENVIRONMENTAL CONSULTING GROUP, LLC ENGINEERING FOR LIFE		PROPERTY LOCATION East Work Area- Stormwater Management Plan Work Area Map	Figure 2
PROJECT NUMBER 4844-001	DATE November 2017		

wp files\4263.001\figure 1 - site location.cdr

Contractor to provide stormwater detention pond to meet the following:

1. Side of inner pond to be at a 3:1 slope
2. Access road around the inner pond to allow for truck traffice
3. Slope outside of the access area to be a 4:1 ratio
4. Contractor to place stormwater pond to capture run off from the drum removal work area
5. Intent of this stormwater pond is to meet the criteria for the Urban Drainage and Flood Management District – Denver Colorado for construction stormwater detention areas

Section A
NTS



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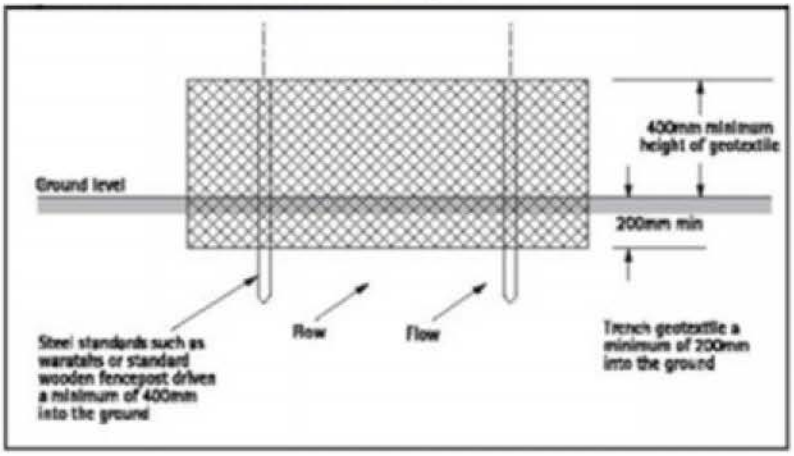
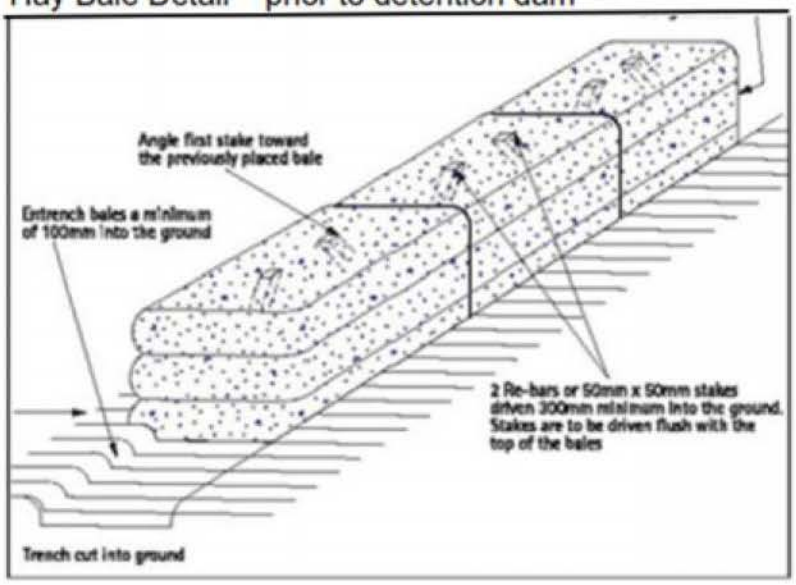
STEWART ENVIRONMENTAL CONSULTING GROUP, LLC ENGINEERING FOR LIFE	PROPERTY LOCATION East Work Area- Stormwater Management Plan Typical Stormwater Pond Configuration	Figure 3
PROJECT NUMBER 4844-001 / DATE November 2017		

wp files\4263.001\figure 1 - site location.cdr

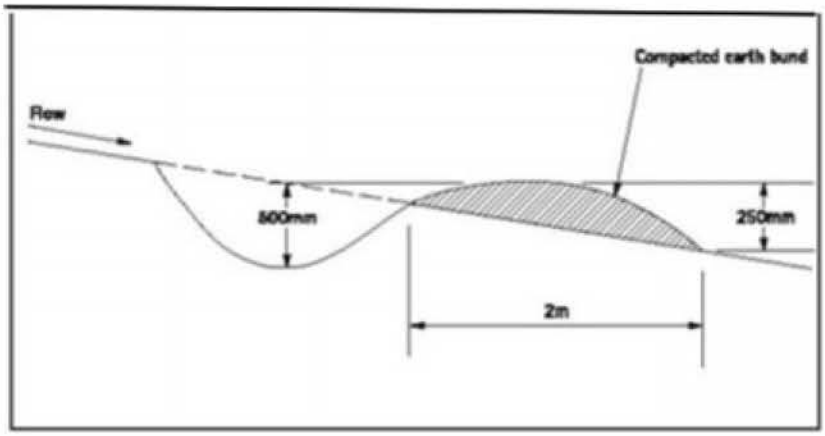
Silt Fence Detail – surrounding work area



Hay Bale Detail – prior to detention dam



Diversion Channel Detail – outside of silt fence



STEWART ENVIRONMENTAL CONSULTING GROUP, LLC ENGINEERING FOR LIFE		PROPERTY LOCATION East Work Area- Stormwater Management Plan Stormwater Plan Details	Figure 4
PROJECT NUMBER 4844-001	DATE November 2017		

wp files\4263.001\figure 1 - site location.cdr

Appendix A

Sample Maintenance Log

Sample Maintenance Log

Control Measure Maintenance Records (copy information below for each control measure)

Control Measure: Insert Name of Control Measure
Regular Maintenance Activities: Describe maintenance activities
Regular Maintenance Schedule: Insert Maintenance Schedule

Date of Action: Insert Date of Action
Reason for Action: ☐ **Regular Maintenance** ☐ **Discovery of Problem**
If Problem,
- Description of Action Required: Describe actions taken in response to problem
- Date Control Measure Returned to Full Function: Insert Date
- Justification for Extended Schedule, if applicable: Insert Justification (if applicable)
Notes: Insert Notes (if applicable)

Equipment and Systems Maintenance Records (copy information below for each equipment/system)

Equipment/Systems: Insert Name of Industrial Equipment/System
Regular Maintenance Activities: Describe maintenance activities
Regular Maintenance Schedule: Insert Maintenance Schedule

Date of Action: Insert Date of Action
Reason for Action: ☐ **Regular Maintenance** ☐ **Discovery of Problem**
If Problem,
- Description of Action Required: Describe actions taken in response to problem
- Date Industrial Equipment Returned to Full Function: Insert Date
- Justification for Extended Schedule, if applicable: Insert Justification (if applicable)
Notes: Insert Notes (if applicable)

Appendix B

Sample Employee Training Log
Sample Training Program Outline

Sample Employee Training Log

Training Date: Insert Date of Training	
Training Description: Insert Description of Training	
Trainer: Insert Trainer(s) names	
Training frequency; Insert frequency of training	
Training topic(s): Insert training topics	
Member(s) trained	**Member(s) signature**
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	

STORMWATER MANAGEMENT
TRAINING OUTLINE

I. **Introduction to National Pollutant Discharge Elimination System (NPDES) Stormwater Permits**

   A. Background information

   B. Status of the permit

II. **Pertinent Components of the Permit**

   A. Stormwater Management Plan (SWMP)

      1. Spill response and cleanup procedures

      2. Good housekeeping procedures

      3. Control measures

         a. Definition and application

         b. Implementation

         c. Maintenance

      4. Inspections

III. **Reporting and Recordkeeping**

IV. **Enforcement**

Appendix C

Inspection Form

STORMWATER INSPECTION FORM
Redtail Drum Removal Construction site
Erie, Colorado

DATE: _____ TIME: _____

INSPECTOR: _____

Weather at time of this inspection?

☐ Clear ☐ Sleet ☐ High winds
☐ Cloudy ☐ Fog ☐ Other
☐ Rain ☐ Snow Temperature: ___

	YES	NO
1.1 Loading/Shipping and Receiving Areas		
a. Is there trash and/or evidence of releases on the docks and/or ground, pavement, and truck access areas around the docks?	☐	☐
b. Are stormwater inlets and collection basins clear of debris?	☐	☐
c. Is there evidence of chemical releases at the stormwater inlets and/or collection basins?	☐	☐

Comments/Corrective Action:

1.2. Drum Storage Area		
a. Are stormwater inlets and collection basin clear of debris?	☐	☐
. Is there evidence of chemical releases at the stormwater inlets and/or collection basins?	☐	☐

Comments/corrective action:

1.3 Trash Roll Off		
a. Is there evidence of releases of hydraulic oil around the compactors?	☐	☐
b. Is the area free of trash?	☐	☐
c. Are stormwater inlets and collection basin clear of debris?	☐	☐
d. Is there evidence of chemical releases at the stormwater inlets and/or collection basins?	☐	☐

Comments/corrective action:

1.4 Parking Areas and Roadways

a. Is there trash and/or evidence of releases on the pavement? ☐ ☐
b. Are stormwater inlets and collection basins clear of debris? ☐ ☐
c. Is there evidence of chemical releases at the stormwater inlets and/or collection basins? ☐ ☐

Comments/corrective action:

1.5 Open Spaces

a. Is there any evidence (unvegetated areas, stained soil, odors, dead animals) of over-applications of chemicals in lawn/landscaping? ☐ ☐

Comments/corrective action:

1.6 Property Boundary

a. Is there evidence of soil erosion and/or sediment potentially impacting stormwater quality? ☐ ☐
b. Is there evidence of broken curbs, gutters, diversions, stormwater barriers potentially impacting stormwater quality? ☐ ☐
c. Is there evidence of chemical releases on curbs, gutters, diversions, stormwater barriers? ☐ ☐

Comments/corrective action:

1.7 New Potential Sources of Stormwater Contamination

a. Are there any new potential sources of stormwater contamination? ☐ ☐

Comments/corrective action:

CERTIFICATION AND COMPLIANCE STATEMENT

In the judgment of either (1) the person conducting the site inspection, or (2) the permittee or duly authorized representative, the Construction site is in compliance with the terms and conditions of the Industrial Stormwater Permit, with respect to Part I.G.2 (Page 20, Inspection Scope): ☐ Yes ☐ No

"I certify that this report is true, accurate, and complete, to the best of my knowledge and belief."

Inspector: _____
Print name and title

Signature: _____ Date: _____

Permittee or Duly Authorized Representative: _____
Print name and title

Signature: _____ Date: _____

Appendix D

Visual Monitoring Requirements

VISUAL MONITORING

ACT Environmental will conduct visual monitoring at the locations indicated on the plan drawings.

The following is excerpted from CDPHE's guidance document:

Once each stormwater precipitation event, for the entire construction project, the permittee must collect a stormwater sample from each outfall (or a substantially identical outfall pursuant to Part I.H.3 above) and conduct a visual assessment of each of these samples.

a. The sample should be collected in such a manner that the sample is representative of the stormwater discharge.

b. The visual assessment must be made of a sample in a clean, clear glass, or plastic container, and examined in a well-lit area. The permittee must visually inspect the sample for the presence of the following water quality characteristics:

   i. Color;
   ii. Odor;
   iii. Clarity;
   iv. Floating solids;
   v. Settled solids;
   vi. Suspended solids;
   vii. Foam;
   viii. Oil sheen; and
   ix. Other obvious indicators of stormwater pollution.

d. **Visual Assessment Corrective Actions.** If the visual assessment indicates the control measures for the construction site are inadequate or are not being properly operated and maintained, the permittee must conduct corrective actions consistent with this plan.

Measurable Storm Events

Rain event. ACT Environmental must conduct all required monitoring on a storm event that results in an actual discharge from the construction site ("measurable storm event"), and that follows the preceding measurable storm event by at least 72 hours (3 days).

Snowmelt event. The permittee must conduct snowmelt monitoring at a time when a measurable discharge occurs from the construction site.

f. **Adverse Weather Conditions.** When adverse weather conditions prevent sample collection according to the relevant monitoring schedule, the permittee must take a substitute sample during the next qualifying storm event. Adverse conditions are those that are dangerous or create inaccessibility for personnel, such as local flooding, high winds, or electrical storms.

HEALTH AND SAFETY PLAN

Redtail Ranch Remediation

1831 Weld County Road 5
Erie, Colorado 80516

November 27, 2017

Project:
624-1201-0027

PSC INDUSTRIAL OUTSOURCING, LP

Health & Safety Plan Acceptance Form 2

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HEAT STRESS/COLD STRESS

SIGNS AND SYMPTOMS OF COLD STRESS

SIGNS AND SYMPTOMS OF HEAT STRESS

SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATIZED WORKERS

TOXIC SNAKE AND INSECT BITES AND PLANTS

HEALTH & SAFETY PLAN ACCEPTANCE FORM

<u>INSTRUCTIONS</u>: This form is to be completed by each PSC employee and anyone providing oversight for the project.

Project Name: **Redtail Ranch Remediation**

Project Number: **624-1201-0027**

I represent that I have read and understand the contents of the above HASP and agree to perform my work in accordance with it. I further more acknowledge that I have been made aware of OSHA Hazard Communication Requirements for this project and Department of Labor Postings.

Sign & Date

_____

_____

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1.0 PURPOSE

The purpose of this Health and Safety Plan (HASP) is to assign responsibilities, establish personnel protection standards and mandatory safety practices and procedures, and provide for contingencies that may arise during site operations. This Plan must be read prior to going into the field to ensure proper planning (e.g., availability of equipment, etc.) and the "Plan Acceptance Form" must be signed by applicable PSC employees. All other consultants and oversight personnel who wish to enter the project site should also sign the "Plan Acceptance Form"

In addition to this Health and Safety Plan, the following additional documents are on file at PSC's Office, 6511 Colorado Blvd., Unit 2, Commerce City, CO 80022:

Training/Medical records for all on-site employees:

- HAZWOPER 8 Hour Refresher Certificate (Current - i.e., within last 12 months);
- HAZWOPER 8 Hour Supervisor Certificate (If applicable);
- Medical Clearance Certificate (e.g., from last annual/biennial physical);
- First Aid/CPR Certification (Current).

For those who may be required to wear positive pressure supplied air respirator, air purifying respirator, or any other respirator:

- Current Respirator Fit Test Record;
- Medical Clearance to wear a respirator (this is normally noted on the Summary Profile for the annual physical).

Other training requirements are as follows:

____ Hydrogen Sulfide (TRC Rule 36)
_____ DOT Hazardous Materials Shipping
__X__ Excavation - Competent Person (minimum of 1 person onsite)
__X__ Confined Space Entry*
- Supervisor
- Entrant
- Standby
- Rescue

_____ NORM Certification
- RSO
- Survey

*Confined Space Entry is not intended, but a potential possibility based upon the excavation.

2.0 APPROVALS

Project Name:	**Redtail Ranch Remediation**
Project Site Location:	**1831 E Weld County Road 5, Erie, Colorado**
PSC Project Manager (PM):	**Jacob Blanton**
PSC Site Safety Officer (SSO):	**TBD**
Dates of Field Work:	**TBD**
HASP Preparer:	**Jacob Blanton**
Preparation Date:	**November 15, 2017**
Expiration Date:	**March 31, 2018**
APPROVAL:	**PSC Area Health & Safety Officer: Jason Farley**

_____

(Signature and Date)

PSC Project Manager: Jacob Blanton

_____

(Signature and Date)

PSC Site Supervisor: TBD

_____

(Signature and Date)

_____

Health and Safety Plan Approval Number

3.0 FIELD PERSONNEL

The project team will consist of the following persons:

Project Manager:	**Jacob Blanton**
Site Supervisor:	**TBD**
Site Safety Supervisor:	**TBD**
Field Personnel:	**Environmental Technicians and Equipment Operators**
Subcontractors:	**Environmental Restoration LLC.**

PSC will require proof of the following health and safety requirements from its subcontractors:

Subcontractor employees may need appropriate training [i.e., either a 40-hour or 24-hour OSHA-required (29 CFR 1910.120) health and safety course for hazardous waste work, or certified equivalent training].

Personnel working at hazardous waste sites must have had an annual physical (or physician's waiver for biennial physical) and be certified "fit for duty" and "fit for respirator use," if necessary, by a qualified physician.

PSC will insist on obtaining proof of both training and a physical before site work may begin.

Personnel must have appropriate personal protective equipment (PPE) for the specific job. All equipment and field operations must meet applicable safety standards.

The subcontractor must sign the Subcontractor Statement of Compliance Form for all onsite employees before site work begins.

4.0 PROJECT DESCRIPTION

4.1 LOCATION

1831 East Weld County Road 5, Erie, Colorado 80516

(See attached site map)

4.2 SITE FEATURES AND BACKGROUND

The project site is located at the Redtail Ranch in Erie, CO. The affected property is located along the west side of County Road Five and near the intersection of Weld County Road Six. Drums of toluene and methyl ethyl ketone (MEK) were buried at the affected property, which operated as a landfill in the late 1960's. Approximately 100 to 150 drums have been identified at the site using geophysical methods.

4.3 DESCRIPTION OF SITE WORK

- **Mobilization Activities**: Mobilization and demobilization of labor, equipment, and materials necessary to perform site activities.

- **Site Controls and Security:** Establish remediation work zones, construct access and egress roads, and set up job trailer. Construct an HDPE lined containment area for drum storage. Construct containment area for impacted soil and clean soil.

- **Excavation and Drum Removal:** Excavate the top layer of clean soil down to the top of drums. Only remove as much material as necessary to facilitate the removal of drums within reach of the excavator. The clean fill will be placed in a designated "clean fill" stockpile area. Once drums are located, the immediate area will be monitored for VOC's and LEL's. Results from monitoring will result in the PPE the employees will don prior to pulling samples, supplied air trailers and multiple PPE levels will be onsite and available. Drum contents will be sampled to verify the material within is consistent, unless otherwise labeled. If levels are safe will begin removing intact drums and overpacking. Drums that are abnormally shaped and/or leaking will be pumped into 55 gallon closed top drums unless contents can be expressly verified. Drums will be labeled and recorded in the immediate removal area and will be labeled permanently at the containment area after further testing as necessary. Once drum contents are verified as not leaking and completely contained we will move drums to containment area.

  Odor Suppression foam will be applied as needed throughout the excavation and drum removal activities.

  Soil removed from around the drums and below will be assumed contaminated and will be excavated and placed in a containment area for profiling and later transportation and disposal.

- **Water Management:** Perched water in the excavation is expected to be minimal but will be pumped into drums as encountered. Decontamination and storm water that is captured will be either placed into drums or larger tank depending upon volume expected.

- **Transportation and Disposal:** Drummed waste and soil will be moved from the containment area and readied for transportation and disposal pending analytical laboratory test results.

- **Demobilization:** Demobilize all personnel, equipment, and supplies from the site.

4.4 PROJECT TEAM ORGANIZATION AND RESPONSIBILITIES

- **Project Coordinator (consultant):** Thomas Krasovec will provide overall project oversight.

- **Project Manager:** Mr. Jacob Blanton will serve as the Project Manager and will be responsible for technical oversight and guidance, regulatory compliance, quality assurance/quality control (QA/QC), overall safety, and communication with the consultant team.

- **Site Supervisor:** The Site Supervisor is yet to be determined for this project. Responsibilities include managing the day-to-day field operations for construction activities, daily assignment for field crew, implementation of site health and safety, and field documentation and reporting.

- **Site Health and Safety Supervisor:** The Site Health and Safety Supervisor is yet to be determined for this project. Responsibilities include oversight for all site health and safety. Proper implementation of the approved Health and Safety Plan. Also, will be performing perimeter air monitoring while all excavation activities occur. Will take daily notes and record daily instrument calibration and air monitoring readings.

- **Environmental Technician(s):** Specially trained personnel who are 40 hour HAZWOPER trained. Responsibilities include execution of daily assignments and compliance with the health and safety plan.

- **Heavy Equipment Operator(s):** Specially trained personnel who can operate various pieces of heavy equipment and have 40 hour HAZWOPER training. Responsibilities include execution of daily assignments and compliance with the health and safety plan.

5.0 HAZARD EVALUATION

Entry into confined spaces or excavations is possible based on current scope of work. If a confined space or excavation is entered the personnel must follow the proper procedures set forth the Job Loss Analysis (JLA) for each task (located in the appendices section).

Tool and/or equipment decontamination will be conducted in accordance with procedures attached in the Appendix. Tool decontamination will be conducted with Alconox™ (or equivalent) and/or hexane as prescribed. Disposable tools will be used wherever applicable.

5.1 WORK LIMITATIONS

In general, fieldwork will be conducted during daylight hours only. Two PSC personnel will be in the field, when possible as the project permits it. The Project Manager or PSC Health & Safety Director must grant special permission for any field activities that would extend beyond a 7:00 AM to 7:00 PM shift and a maximum of seven consecutive days of work.

5.2 WASTE TYPES POTENTIALLY ENCOUNTERED

Liquid: X Solid: X Sludge: X Gas: X
Vapor: X

The individual soil and/or groundwater contaminants found in previous investigation are listed below:

- DCE
- MEK's
- Metals
- TCE
- THF
- Toluene

5.3 CHARACTERISTICS OF WASTE

Corrosive:	X	Ignitable:	X	Radioactive:	
Volatile:	X	Toxic:	X	Reactive:	X
Unknown:	X	Oxidizers	X		

5.4 ROUTES OF EXPOSURE

Inhalation	X	Skin/Eye Contact	X
Ingestion	X	Skin Absorption	X

Site personnel can reduce their exposure potential by:

- Using the proper PPE;
- Practicing contamination avoidance;

- Following proper decontamination procedures; and,
- Observing good personal hygiene.

5.5 EXPOSURE MONITORING

Exposure monitoring will be required for this project. The type, frequency, and details related to this monitoring are provided in Table 3. Instrumentation required for this monitoring is as follows*:

_____	Explosimeter
_____	Oxygen Meter
__5__	PID – Rae ppb
__3__	4 Gas Meter (LEL, VOC, O2, CO)
_____	Photoionization Detector (PID)
_____	Flame Ionization Detector (FID)
__1__	Draeger Tubes
	(Specify Type) _____

Only personnel who are familiar with the proper use and limitations will perform exposure monitoring. Instruments will be calibrated prior to use in accordance with manufacturer's recommendations. A log of this calibration shall be maintained on the "Equipment Calibration -Log Form" provided in the "FORMS" section of this HASP.

Air Monitoring Readings will be recorded in the field using the "Air Monitoring Data Form" located in the "Forms" section. These readings will be transferred to an electronic form at the end of the day and electronically submitted to the consultant.

Specifics to the overall ambient air monitoring plan can be found by referring to the Project Ambient Air Monitoring Plan (AAMP). Specific action levels can be found in Table 3.

5.6 CHEMICAL AND PHYSICAL PROPERTIES OF HAZARDOUS SUBSTANCES

The exposure limits, recognition qualities, acute and chronic effects, and first aid treatments for hazardous chemicals expected to be found at the site are presented in Table 1 (Exposure Limits and Recognition Qualities) and Table 2 (Health Hazards and First Aid).

5.7 INITIAL LEVEL OF PROTECTION

The levels of protection for this project will vary depending upon site conditions and air monitoring. The initial level of protection for this project will be **Level C.**

Level A _____ Level B _____ Level C __X__ Level D _____

Level of Protection	**Protective Equipment Ensemble**
D	***Coveralls or work clothes*** • Coveralls required when in contact with waste materials: ***Work gloves (as needed)*** • Impermeable gloves and inner gloves required when in contact

with waste materials:
- **Nitrile or Latex** (inner)
- **Nitrile** (outer)

Safety boots, leather, steel toe

- Rubber (latex) overboots for incidental contact with waste materials to protect leather work boots

-or-

- 16 inch PVC boots with steel toe and shank for extended contact

Safety glasses

- Splash goggles or Safety glasses required for incidental eye contact with liquid chemicals or contaminants

Hard hat

Hearing protection (when in proximity to heavy equipment or other noise generating sources)

Reflective safety vest

C

Air purifying respirator (half face or full face) with HEPA, Organic Vapor/Acid Gas cartridges

Chemical resistant coveralls

- PVC,
- Polycoated Tyvek or Saran disposables

Hard hat

Inner and outer chemical resistant gloves (Nitrile or Latex inner and Nitrile outer)

*16 inch **PVC** boots with steel toe and shank*, or

- Leather boots, steel toe with rubber outer boots

Hearing protection (when in proximity to heavy equipment or other noise generating sources)

Safety glasses *(if wearing half face respirator)*

- Splash goggles or Safety glasses required for incidental eye contact with liquid chemicals or contaminants

Reflective safety vest

B

Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure ***supplied air respirator*** with escape

SCBA (NIOSH approved).

Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls)

Inner and outer chemical resistant gloves (Nitrile or Latex inner and Nitrile outer)

Boots, outer, chemical resistant steel toe and shank or Boot-covers, outer, chemical resistant (disposable)

Hearing protection (when in proximity to heavy equipment or other noise generating sources)

5.8 SITE CONTROL

To prevent the accidental spread of contaminants, as a minimum, three zones will be delineated on the site*:

Exclusion Zone (EZ) The exclusion zone will encompass the work area and will be demarcated with red "**DANGER - DO NOT ENTER**" barrier tape, if necessary (or equivalent yellow caution tape), with orange safety fence, or with traffic cones. Only authorized personnel may enter this area wearing the specified level of protection.

Contamination Reduction Zone (CRZ) The contamination reduction zone will consist of a lane into and out of the EZ which will adequately accommodate decontamination station(s) as necessary. Access and egress for each EZ will only be allowed through the CRZs. Only authorized personnel wearing the specified level of protection may enter this area. In general, decontamination at the site consists of rinsing equipment, personnel, etc., with copious amounts of water and washing with detergent water solutions. The spent solution, brushes, sponges, containers, stands, as well as all disposable PPE, sampling equipment must be properly disposed.

Support Zone (SZ) The support zone will be located beyond the CRZ and will include the remaining portions of the site. No specific project-related personal protective equipment (PPE) is required in this zone.

EMERGENCY SPILL RESPONSE:

In the event a spill occurs onsite PSC will have appropriate spill response equipment onsite to manage and quickly contain the spill. PSC intends to work on one drum at a time and will not move to the next until it is properly contained, therefore minimizing the risk of spills to a maximum of one 55-gallon drum at a time.

5.9 HAZARDS ANALYSIS FOR SITE TASKS

In addition to the specific hazards listed below, Job-Loss Analyses (JLA's) have been provided for each job task in the forms section.

5.9.1 Chemical Hazards

Moderate to elevated levels of contaminants listed in section 5.2 and 5.3 may be present in soil and other construction materials.

5.9.2 Fire and Explosion Hazards

The potential for encountering product or free liquid contamination is high. The potential for encountering soils or groundwater saturated with product or free liquid contamination is moderate; consequently, the fire and explosion hazard is medium-high for this project during the field activities. All possible sources of ignition should be minimized within the Exclusion Zone.

Non-Sparking tools will be required when working with the drums or while in the exclusion zone.

Gasoline is very flammable and, if used, must be handled safely. Most fuel gases and vapors are heavier than air and may accumulate in low lying areas under certain conditions.

PSC and its subcontractors are not allowed to smoke while in the exclusion zone or the CRZ. An area may be designated near the support zone for smoking but will be based upon site conditions.

Based on the preceding information, a “Hot Work Permit” will not be required on this project.

Instrumentation/Action Level guidelines as specified in Table 3 must be followed.

5.9.3 Physical Hazards

Physical hazards such as slips, trips, and falls may occur. Workers must walk cautiously at the site to avoid tripping, especially when uneven terrain is present. Falls are more serious when they occur from heights. Extra precautions must be taken if guardrails or railings are absent. Ladders used for access to a high place should be securely lashed or otherwise fastened at the top to prevent sliding and the feet must be on a firm and level base. Vehicles used at a site can strike workers. While driving in reverse, the operator usually has a more limited field of view than while driving forward and must observe extra caution.

On-site Traffic: Moving heavy equipment and truck traffic is expected at the site. Extra precaution is recommended before and during walking around the site to look for moving vehicles. Safety vests must be worn at all times while on-site. While walking around at the site, make sure you make eye-contact with all vehicle operators so they know you are there. The work zone should be marked with cones, barricades or caution tape to warn on-site traffic to stay clear.

Material Handling: Accidents in manual handling of materials are primarily the result of unsafe working habits--improper lifting, carrying too heavy a load, incorrect gripping, or failing to wear personal protective equipment. These may be avoided by testing the weight of an object before attempting to lift and carry it. If it is too heavy, get help or use mechanical lifting aids.
The proper method for lifting is:

- Get a good footing.
- Place your feet about shoulder width apart.
- Bend knees to pick up load. Never bend from waist.
- Keep back straight.
- Get a firm hold. Grasp opposite corners of the load, if possible.
- Keep the back as upright as possible.

- Lift gradually by straightening the legs--don't jerk the load.
- Keep the weight as close to the body as possible.
- When changing directions, turn the entire body, including the feet.
- Don't twist the body.

5.9.4 Biological Hazards

Biological hazards may include venomous snakes, insects, animals (rabid) and allergenic plants. Site personnel prior to beginning work should review information attached in the Appendix.

5.9.5 Electrical Hazards

Utility clearance will be performed prior to any soil penetration activities. The "Utilities and Structures Checklist" form in the Appendix shall be completed prior to soil penetration activities. The work area will be inspected to verify no possibility of contact with overhead utilities. **A buffer zone of at least 15 feet from overhead utilities must be maintained.**

Any electrical power tools must be connected to GFCI (ground fault circuit interrupter) protected circuits. All power cords must be inspected for damage prior to use. *Please note that electric power tool(s) are not permitted for use in the exclusion zone unless they are intrinsically safe.*

5.9.6 Heat/Cold Stress

Exposure to high/low temperatures may occur during field activities. Precautions will be implemented by the SSO as described in the information found in the Appendix. Monitoring procedures as described in the Appendix shall be implemented as required.

5.9.7 Noise Hazards

Hearing protection is required for work performed adjacent to operating heavy equipment or other noise generating sources.

5.9.8 Permits

Based on the type of work being performed, the following permits may be required for this project:

X	Confined Space Entry Permit
X	Excavation Permit (by Site Supervisor or Excavation Competent Person)

5.9.9 Other Hazards

PSC staff shall stay out of the operating range of the equipment while on site. The "operating range" is defined as a 20 feet radius around the operating equipment. Entry into the operating range is allowed only after the operator's attention has been gained and his/her permission given to enter.

Potential Asbestos-Containing Materials (ACM's) – There is a potential to come across ACM's while excavating. An asbestos-trained individual will be onsite to monitor activities and can spot suspect ACM's if encountered. If the suspect ACM's are deemed to be asbestos-containing than an approved subcontractor will provide the asbestos abatement necessary.

5.10 HAZARD COMMUNICATION

The following chemicals will be used on site for this project. Safety Data Sheets (SDSs) are attached to this plan.

- Alconox

5.11 HAZARDOUS MATERIALS SHIPPING

The shipping of identified hazardous materials shall be done in accordance with applicable DOT regulations, as appropriate.

6.0 EMERGENCY INFORMATION

6.1 EMERGENCY CONTACTS

Contact	Person or Agency	Telephone No.
Police	Erie Police Department	**911 or (303) 926-2800**
Fire	Protection Mountain View Fire	**911 or (303) 828-9355**
Ambulance	Northglenn Ambulance	**911 or (303) 451-6882**
Hospital (Emergency Care)	Centura Health Emergency & Urgent Care 4943 State Highway 52 Dacono, CO 80514 (303) 925-4840 (see attached map and directions)	**(303) 925-4840**
PSC - Project Manager	**Jacob Blanton**	**Cell: (314) 799-9651** **Office: (618) 281-1531**
PSC - Area Health & Safety Officer	**Jason Farley** **210 West Sand Bank Road** **Columbia, IL 62236**	**Office: (270) 252-6190** **Fax: (618) 281-5120**

6.2 LOCATION OF SITE RESOURCES

Water Supply: Limited but available onsite

Telephone: Mobile cellular telephone required.

Toilet: Portable restrooms in the support zone

6.3 LOCATION OF HOSPITAL/CLINIC

The nearest emergency room is located at 4943 State Highway 52, Dacono, CO 80514 and is approximately 6.3 miles northeast from the site. The hospital location map/directions can be found in the “figures” section.

6.4 EMERGENCY MEDICAL TREATMENT PROCEDURES AND BLOODBORNE PATHOGEN EXPOSURES

6.4.1 Emergency Medical Treatment

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered

prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. First aid kits will have gloves and artificial airways to protect against bloodborne pathogens, and personnel who have come into contact with bodily fluids such as blood or saliva will immediately confer with the PSC Environmental Health & Safety Director to determine whether inoculation or other action is necessary. All injuries and illnesses must be reported immediately to the Project Manager.

Personnel who are transported to a clinic or hospital for treatment should take with them information on the chemical(s) they have been exposed to at the site. This information is included in Table 1, Exposure Limits and Recognition Qualities.

Any vehicle used to transport contaminated personnel will be treated and cleaned, as necessary.

6.4.2 Bloodborne Pathogens

For purposes of this health and safety plan, employees have jobs where required tasks normally do not but could involve exposure to blood, bodily fluids, or tissues--for example, in the event first aid or CPR is required. If exposure to blood, bodily fluids, or tissues occurs, Universal Precautions, such as described in the Appendix, should be followed to minimize the chance of contracting disease and the “Bloodborne Pathogens Incident Evaluation Form” must be completed and submitted (FORMS section).

OSHA required Bloodborne Pathogens Infection Protection Packs are required on-site for the duration of the project.

7.0 MISCELLANEOUS

7.1 POSTING OF OSHA POSTER FOR PRIVATE INDUSTRY FORM

Not Required

7.2 ADDITIONAL REQUIRED EQUIPMENT TO BE TAKEN INTO FIELD

- First aid kit (with eye wash)
- Thermometer (for heat stress monitoring)
- OSHA-required Bloodborne Pathogens Infection Protection Packs
- Instrumentation as specified in Section 5.5
- Equipment calibration gas/supplies
- PPE, including reflective vests
- Barricade tape
- Fire extinguisher - 5lb ABC
- Decontamination supplies (Alconox, wash tubs, brushes, containers for waste)

7.3 WORKER TRAINING RECORDS

Worker Training Records are on file in the PSC Columbia, Illinois office.

7.4 SITE SAFETY MEETINGS

Site safety meetings will be conducted prior to each shift by the SSO and documented using the "Site Safety Meeting Record" or the "Job Loss Analysis" (JLA) (FORMS section).

7.5 FIELD FORMS TO BE USED

Copies of the following forms will be completed in field:

- Plan Acceptance Form
- Subcontractor Statement of Compliance Form
- Equipment Calibration Log
- Air Monitoring Data Log
- Job Loss Analysis
- Utilities and Structures Checklist

Copies of the following forms will be available with the HASP and used, if applicable:

- Bloodborne Pathogens Incident Evaluation Form
- Supervisor's Accident/Injury Investigation Report

TABLES

TABLE 1
EXPOSURE LIMITS AND RECOGNITION QUALITIES

COMPOUND	EXPOSURE STANDARDS			SKIN ABSORBED	RECOGNITION QUALITIES		
	TLV/PEL (ppm)	STEL (ppm)	IDLH (ppm)		ODOR THRESHOLD (ppm)	LEL (%)	IONIZATION POTENTIAL (ev)
Benzene	0.5	--	500	Yes	12	1.30	9.24
Ethyl benzene	100.0	125	800	--	2.3	1.00	8.76
2-Butanone (Methyl ethyl ketone)	200.0	300	3,000	--	0.25	1.40	9.54
Toluene	20.0	150	500	--	2.9	1.20	8.82
Trichloroethene (TCE)	10.0	25	1,000		28	8.0	9.45
Xylenes	100.0	150	900	--	1.1	1.00	8.56
PCBs	0.5*	--	5*	Yes	mild hydrocarbon	--	--

TLV/PEL = The more stringent of either the American Conference of Governmental Industrial Hygienist' (ACGIH) threshold limit value or the Occupational Safety and Health Administration (OSHA) permissible exposure limit.
STEL = Short term exposure limit based on a 15 minute time weighted average.
IDLH = Immediately dangerous to life and health.
ppm = Parts per million
LEL = Lower explosive limit
* = Milligrams per cubic meter

TABLE 2
HEALTH HAZARDS AND FIRST AID

COMPOUND	SYMPTOMS	TARGET ORGANS
Benzene	Irritated nose & respiratory system, giddy, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitis, bone marrow depression, carcinogen	Blood, central nervous system, skin, bone marrow, eyes, respiratory system
Ethyl benzene	Irritated mucous membranes, headache, dermatitis, narcosis, coma	Eyes, upper respiratory system, skin, central nervous system
2-Butanone (Methyl ethyl ketone)	irritation eyes, skin, nose; headache; dizziness; vomiting; dermatitis	Eyes, skin, respiratory system, central nervous system
Trichloroethylene (TCE)	irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system
Toluene	Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, muscle fatigue, insomnia, dermatitis	Central nervous system, liver kidneys, skin
Xylenes	Dizziness, excitement, drowsiness, incoherent staggering gait, irritated nose & throat, anorexia, nausea, vomiting, abdominal pain, dermatitis	Central nervous system, eyes, gastrointestinal tract, blood, liver, kidneys, skin

NOTE: General First Aid Treatment

Eye:	**IRRIGATE IMMEDIATELY**
Skin:	**SOAP WASH PROMPTLY**
Inhalation:	**MOVE TO FRESH AIR**
Ingestion:	**GET MEDICAL ATTENTION**

TABLE 3
HAZARD MONITORING METHODS, ACTION LEVELS, AND PROTECTIVE MEASURES

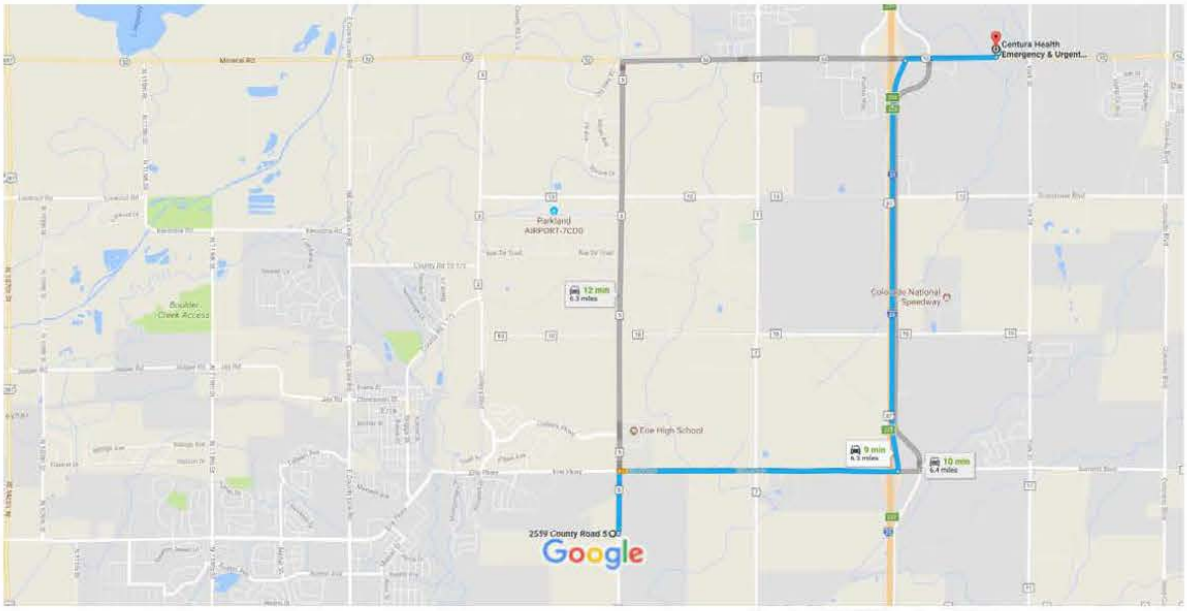
HAZARD	MONITORING METHOD	ACTION LEVEL	MONITORING SCHEDULE	PROTECTIVE MEASURES
Organic vapors	PID (with 10.2ev lamp)	Up to 5 ppm above background in the breathing zone	Periodically (every 30 minutes) during invasive field activities	Level D
		5-50 ppm	Periodically (every 30 minutes) during invasive field activities	Level C
		>50 ppm	Periodically (every 30 minutes) during invasive field activities	Level B or EVACUATE AREA
Oxygen deficient atmosphere	0_2 meter	20.8% - 23%	Continue operations	
		<20.8%	Continuous monitoring	
		≤19.5%	Do not enter. Ventilate and determine if supplied air is required.	Level B
		>23%	Fire explosion hazard. Withdraw from area immediately	
Explosion	CGI	< 5% LEL	Continue operations	
		> 5% LEL	Explosion hazard. Ventilate until levels fall below 5% or inert tank in accordance with attached Confined Space Entry Procedure.	

FIGURES
Site Map
Hospital Map and Directions

Site Map – 2559 County Road 5, CO to Centura Health Emergency & Urgent Care

2559 County Road 5, Erie, CO to Centura Health Emergency & Urgent ... https://www.google.com/maps/dir/2559+County+Road+5,+Erie,+CO/Ce...

Google Maps **2559 County Road 5, Erie, CO to Centura Health Emergency & Urgent Care - Frederick** Drive 6.3 miles, 9 min



Map data ©2017 Google 2000 ft

2559 Co Rd 5
Erie, CO 80516

Drive from Weld County Rd 8 and I-25 N to Frederick

8 min (6.2 mi)

1. Head north on Co Rd 5 toward Erie Pkwy/Weld County Rd 8

0.5 mi

2. Turn right onto Erie Pkwy/Weld County Rd 8
   Continue to follow Weld County Rd 8

2.0 mi

3. Turn left onto the Interstate 25 N ramp

0.3 mi

4. Merge onto I-25 N

2.4 mi

5. Take exit 235 for CO-52 toward Dacono/Ft Lupton

0.4 mi

6. Turn right onto CO-52 E/State Hwy 52 E (signs for Dacono/Ft Lupton/Frederick)

0.7 mi

Drive to your destination

1 min (420 ft)

7. Turn left

167 ft

8. Turn right

108 ft

9. Turn left

Destination will be on the left

144 ft

Centura Health Emergency & Urgent Care - Frederick

4943 State Highway 52, Dacono, CO 80514

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

FORMS

UTILITIES AND STRUCTURES CHECKLIST

Project: Redtail Ranch Remediation Prepared by: _____
Location: 2559 County Road 5, Erie, Colorado

Instructions: This checklist has to be completed by a PSC staff member as a safety measure to ensure that all underground utility lines, other underground structures as well as above-ground power lines are clearly marked out in the area selected for boring or excavation. **DRILLING OR EXCAVATION WORK MAY NOT PROCEED UNTIL LINES ARE MARKED AND THIS CHECKLIST HAS BEEN COMPLETED**. Arrangements for underground utility markouts are best made at the time of the preliminary site visit to allow client and/or utility company sufficient time. Keep completed checklist and maps onsite; send copy to Project Manager.

Client Approval: Client is responsible for having private underground utilities and structures located and marked.

State Utility Call-In: Colorado811

Phone Number: 1-800-922-1987
Ticket Number: Attached with Hasp

Drilling or Excavation Sites: Attach a map of the property showing the proposed drilling or excavation site (or if sites are widely separated, several maps) clearly indicating the area(s) checked for underground utilities or underground structures and the location of above-ground power lines.

UTILITIES AND STRUCTURES (Complete on site)

TYPE	**NOT PRESENT**	**PRESENT**	**MARKED [1]**
Petroleum product line			
Natural gas line			
Steam line			
Water line			
Sewer line			
Storm drain			
Telephone cable			
Electric power line			
Product tank			
Septic tank/drain field			
Overhead power line			

[1] Flags, paint on pavement, wooden stakes, etc.

SUBCONTRACTOR STATEMENT OF COMPLIANCE FORM

This confirms that subcontractor personnel listed below are qualified by training and experience to work at the site in compliance with the applicable subcontract agreements between PSC and the following subcontractors:

The subcontractor personnel are properly trained and medically fit to perform the necessary project activities as required by the subcontract agreements and will perform their activities safely in accordance with 29 CFR 1910 and 1926 and any other federal, state, or local requirements.

Subcontractor Authorized Representative and Employee Names (Print & Sign):

1. _____ 4. _____

2. _____ 5. _____

3. _____ 6. _____

JLA WORKSHEETS

Job Loss Analysis

Loss Prevention System™
An integrated process to maximize business performance

Minimum Personal Protective Equipment (PPE)

☐ Goggles	☐ Safety Back Belt	☐ Safety Cones	☐ Welding Hood
☐ Face Shields	☒ Hearing Protection	☐ Warning Device	☒ Gloves Per HASP
Safety Glasses	Hard Hat	Tagout/Lockout Kit	Other
☒	☒ Safety Shoes	☐ Hi-Viz Jacket	☐ Other
	☒	☐	☐

	Pre-job Preparation		
	Job Steps	**Potential Risks**	**Critical Actions**
1	Employees fit for duty.	EEs working while not physically, mentally, or emotionally fit could cause equipment damage or personal injury.	Supervisor should evaluate EEs for mental, physical, and emotional fitness before and during work. Remove EE if concerned.
2	Verify site is accessible.	Failing to verify site with project manager (PM) or contact may result in access issues.	Confirm site is accessible with PM or contact.
3	Confirm state one-call is completed.	If drilling, work will be delayed if utilities are not marked.	Verify state one-call is completed.
4	Review sampling standards and state regulations.	Personnel who are not familiar with sampling standards could cause delay or resampling.	Review ASTM or PSC Sampling Standards and project-specific sampling needs and protocols with PM. Review state regulations as appropriate.
5	Review work plan and confirm all equipment is available.	Incorrect sampling equipment and sampling supplies can cause lost time.	Review work plan/scope of work for sampling activities, especially sample analysis. Review Health and Safety Plan (HASP) and update. Check all sample containers and supplies are available.
6	Confirm proper PPE.	Not having and using proper PPE when handling/sampling hazardous materials (asbestos, lead, PCBs) could expose personnel to levels above permissible exposure limits (PELs).	Check HASP and SDS for all proper PPE. Wearing proper PPE and follow proper decontamination procedures.
7	Confirm equipment is in good condition.	Broken/faulty equipment can delay field work.	Confirm equipment is in good condition before going to field.
8	Bring required certifications.	Failing to bring appropriate certifications (if necessary) could result in work delays.	Bring current certifications as required.
9	Review proper labeling and storage standards.	Improper investigation derived waste (IDW) labeling and storage may result in fines, leakage or damage to drums.	Review labeling standards and bring appropriate labels. Discuss proper storage and handling of IDW with PM.

	Initial On-site Preparation		
	Job Steps	**Potential Risks**	**Critical Actions**
1	Review drawing or map of sampling site and walk through site.	Not being familiar with sampling site layout and hazards could result in injury or property damage.	Review drawing or map of sampling site(s). If no drawings are available, make a hand drawing. Walk through site to locate and confirm sampling locations and hazards.
2	Conduct safety meetings, complete forms and put on PPE.	Not being familiar with hazards or using improper PPE could result in injury.	Conduct safety meeting, review HASP and conduct LPSAs. Fill out JSA if client requires. Put on appropriate PPE.
3	Prepare for proper decontamination.	Improper decontamination or failing to follow proper sampling techniques can result in unusable analytical data.	Set up decontamination area and review sampling standards and decontamination techniques to prevent cross-contamination.

	Sampling Activities		
	Job Steps	**Potential Risks**	**Critical Actions**
1	Clear travel paths in sampling area and wear proper PPE.	Debris in travel paths in sampling area could cause personnel to trip and drop, break or splash liquid samples, resulting in chemical burns.	Set up sampling area securely and make sure travel paths are clear. Wear chemical-resistant PPE when filling or transporting chemicals. Make sure caps are secure.
2	Follow sampling protocols.	Improper sampling techniques could lead to resampling.	Follow sampling protocols according to standards or procedures.

3	Follow decontamination protocols.	Cross-contamination of samples or improper documentation of decontamination could result in unusable lab data.	Wear and remove disposable gloves properly. Discard disposable sampling equipment as required. Properly decontaminate sampling equipment as required.

4	Follow work plan and scope.	Incomplete data collection could result in additional trips to site.	Follow entire work plan/scope to completion. Check in with PM before subcontractors are dismissed from job site. Mark sample locations on drawings or maps. Take pictures to log sampling activities (if required by project PM or client).
Post-sampling Activities			
	Job Steps	**Potential Risks**	**Critical Actions**
1	Document samples properly.	Improper sample documentation or labeling could result in unusable data or incorrect sample analysis.	Complete sample labeling and chain of custody forms properly according to Sampling Standards.
2	Pack samples properly.	Improperly packing samples in shipping containers could result in broken sample containers and require resampling.	Follow procedures for packing, icing or other preservation to ensure safe shipping.
3	Store samples properly.	Samples not stored at appropriate temperature or in a manner that breaks chain of custody could result in resampling.	Follow correct storage and packing procedure for samples (e.g., place samples under ice in double zippered bags). Make sure samples remain in personal custody until delivered/shipped to lab.
4	Ship samples properly.	Samples not delivered to the laboratory within appropriate timeframe could require resampling.	Complete shipping labels with correct shipping address, phone number and delivery time. Contact courier in advance to ensure on-time delivery
5	Label and store waste properly.	Improperly stored or labeled waste could result in fines or exposure.	Properly label and store waste according to appropriate standards or SOP.
6	Clean up sampling sites.	Site not properly restored or cleaned up could result in additional clean-up costs.	Conduct post-sampling site walk through (with client or site tenant) before leaving site to ensure site is acceptable.

Site-Specific Hazards that Require Action	
Potential Risks	**Critical Actions**

Date:_____ Emergency #:_____Time:_____ Supervisor:_____

	Name Time	Name Time	Name Time
In			
Out			

**Your signature above indicates that you are aware of your responsibility to report any illness, injury or fatigue issues to your Supervisor.*

Job Loss Analysis

Loss Prevention System™
An integrated process to maximize business performance

Minimum Personal Protective Equipment (PPE)

☐ Goggles	☐ Safety Back Belt	☐ Safety Cones	☐ Welding Hood
☐ Face Shields	☒ Hearing Protection	☐ Warning Device	☒ Gloves per SDS
☒ Safety Glasses	☒ Hard Hat / Bump Cap	☐ Tagout/Lockout Kit	☒ Other
	☒ Safety Shoes	☐ Hi-Viz Jacket	☐ Other

Arriving at Site

	Job Steps	Potential Risks	Critical Actions
1	Employees fit for duty.	EEs working while not physically, mentally, or emotionally fit could cause equipment damage or personal injury.	Supervisor should evaluate EEs for mental, physical, and emotional fitness before and during work. Remove EE if concerned.
2	Follow client and PSC rules and procedures.	Not following client and PSC rules and procedures (including PSC zero-tolerance rules) can lead to removal from client site, disciplinary action (up to and including termination) and serious injury or death.	Comply with all client and PSC safety instructions, procedures, posted signs and instructions. If client and PSC safety rules disagree, follow rule that offers the most protection.
3	Locate and know how to use all safety equipment and evacuation routes.	Not knowing location of safety equipment and evacuation routes could lead to lost time, property damage and serious injury or death.	Locate and know how to use fire extinguishers, safety showers, eye wash stations and all safety equipment in area. Know work location, control room and on-site first responder phone and emergency numbers and client contact information.
4	Review SDS and wear required PPE.	Work area may contain hazards that can result in splinters, cuts, crushing hazards to hands, back/muscle strains, hearing loss, eye injuries, chemical burns, chemical reactions and serious injury or death.	Review SDS for materials at work site. Wear PPE prescribed by posted signs, established operating procedures, written instructions and work permits.
5	Obtain work permit.	Not having work permit may result in unknown hazards (e.g., other contractors' work, client projects and unsafe conditions) and result in injury or death.	Obtain a properly executed work permit as required by PSC procedures or established client/plant safety rules.
6	Review weather conditions.	Inclement weather conditions, including heat and/or humidity, can introduce hazards in work environment result in injury or death.	Evaluate weather conditions in area. Have adequate supply of fluids on site hydrated. Understand and follow Heat Stress Prevention Policy (PSCEHC-1600), Heat Stress Plan and PSC Heat Index Chart.

Incident Reporting

	Job Steps	Potential Risks	Critical Actions
1	Report all injuries and incidents immediately.	Failing to report immediately can damage the client relationship, conceal facts that could help prevent reoccurrence, worsen injury due to not receiving proper treatment or cause lost time/wages or serious injury/death.	Report all injuries to supervisor immediately, regardless of severity. Report all near losses/losses so that near loss/loss investigation can be conducted and solutions can be put in place.

General Labor

	Job Steps	Potential Risks	Critical Actions
1	Use proper lifting and work techniques; follow speed limits and wear seat belts; use spotter for backing up.	Work may include walking around job site, loading/unloading equipment, entering/exiting buildings, lifting objects and driving.	Use lifting techniques (keep back straight and use leg muscles). Ask for help to lift or move large/heavy items. Use forklift, jack or dolly if possible. Follow speed limit signs on job site and wear seatbelt at all times. Use spotter to back vehicle up.
2	Wear fall protection; take precautions to avoid being hit by vehicles or caught between objects.	OSHA "big four" hazards on all job sites include falls, struck-by, caught-in or -between and electrocution (these four make up 90% of workplace fatalities).	Wear fall protection when working above 4 ft. on PSC property and 6 ft. in plant. Watch for vehicles and communicate intended walking path to all drivers to avoid being hit. Do not stand between load and other object. Keep body parts away from moving machinery parts.
3	Do not fall asleep on the job.	Falling asleep during a job could result in injury to self and/or others.	Sleeping on the job is not allowed. **IDLH**

Vehicle Safety			
	Job Steps	**Potential Risks**	**Critical Actions**
1	Only operate Company vehicles if qualified and authorized to do so.	Unqualified drivers or operators of vehicle can lead to loss of privileges, loss of income, serious injury/ death.	Only qualified authorized personnel operate any company vehicle. Driver's badge required to be displayed in conspicuous area.
2	Follow PSC and client rules for all vehicle drivers and passengers.	Not following PSC and/or client vehicle rules can result in loss of income, loss of privileges, lost time and serious injury or death.	All vehicle occupants must wear seatbelts. No passengers allowed unless equipment is designated to carry passengers. No more than three persons in a bench seat in cab of truck. If client/local laws allow, passengers riding in truck beds must keep all body parts inside bed.
3	Keep vehicles clean, secure items in cab and do not use phone while driving.	Unsecured items in vehicle can cause distracted driving, motor vehicle accident and serious injury or death.	Keep vehicles clean. Secure all items in cab before driving.
4	Do not use cell phone while driving.	Using a cell phone without a hands-free device can cause a motor vehicle accident.	Use a hands-free device when talking on a cell phone. Never text while driving. **IDLH**

Housekeeping			
	Job Steps	**Potential Risks**	**Critical Actions**
1	Follow proper housekeeping rules.	Improper housekeeping can result in returning to job site, resulting in lost time, damaged client/contractor relationship and injury.	Place trash and scrap metal in proper containers. Keep emergency equipment and exits/travel paths clear. Return all tools, equipment and supplies to storage.

Leaving Site			
	Job Steps	**Potential Risks**	**Critical Actions**
1	Turn in, sign off on and cancel permits according to client policy.	Not turning in permits, signing off on or canceling permits for shift can result in lost time and damage to client relationship.	Follow client policy for turning in, signing off on or canceling permits.
2	Follow site policies for exiting site.	Violating client rules for exiting site may result in lost time/wages, EE and/or crew dismissal from site and/or damaged client relationship.	Follow all site policies for exiting facility. Report any badge issues immediately to avoid not having record of entry/exit.

Site-Specific Hazards that Require Action	
Potential Risks	**Critical Actions**

Date:_____ Emergency #:_____Time:_____ Supervisor:_____

	Name Time	Name Time	Name Time
In			
Out			

**Your signature above indicates that you are aware of your responsibility to report any illness, injury or fatigue issues to your Supervisor.*

Job Loss Analysis

Loss Prevention System™
An integrated process to maximize business performance

Minimum Personal Protective Equipment (PPE)

☐ Goggles	☐ Safety Back Belt	☐ Safety Cones	☐ Welding Hood
☐ Face Shields	☒ Hearing Protection	☐ Warning Device	☒ Gloves Leather
Safety Glasses	Hard Hat	Tagout/Lockout Kit	Other Open Cab (Hard Hat)
☒	Safety Shoes ☐	Hi-Viz Jacket ☐	Other ☒
	☒	☐	☐

Walk Job Site with Spotter

	Job Steps	Potential Risks	Critical Actions
1	Employees fit for duty.	EEs working while not physically, mentally, or emotionally fit could cause equipment damage or personal injury.	Supervisor should evaluate EEs for mental, physical, and emotional fitness before and during work. Remove EE if concerned.
2	Identify hazards with paint and signs.	Unforeseen hazards such as unmarked barriers, hidden objects and knocked-down overhead power lines can cause injury or equipment damage.	Paint potential hazards. Place signs 10 ft. out from powers line and straight down to mark safety curtain.
3	Wear gloves and snake chaps.	Personnel could suffer snake or insect bites in tall grass or brush.	Wear leather gloves and snake guards if in known snake habitat.
4	Use traffic control.	In high-traffic areas, someone could be hit by a vehicle and seriously injured.	Use traffic control as needed to avoid incidents.

Verify USA Dig Alert

	Job Steps	Potential Risks	Critical Actions
1	Walk lines with field personnel and confirm lines are flagged.	Unknown lines may burst or cause fire or explosion if hit.	Walk lines with field personnel. Verify lines have been flagged or marked.
2	Review and confirm permits.	Incorrect or missing permits may cause work to be done wrong or loss of job.	Review permits with permit issuer and supervisor.

Equipment Inspection

	Job Steps	Potential Risks	Critical Actions
1	Use three points of contact.	Personnel can fall when climbing in and out of equipment.	Use three points of contact when climbing in and out of equipment.
2	Confirm there is no stored energy and avoid pinch points.	Equipment can move due to stored energy creating pinch points between hydraulic rams, which can crush or break body parts.	Make sure there is no stored energy by moving controls with equipment off and keys removed. Use proper hand and body placement.
3	Inspect equipment.	Inadequate inspection could result in hydraulic leaks from faulty hoses or fittings.	Inspect equipment for proper operation and damage.
4	Maintain equipment properly.	Unmaintained equipment could result in equipment breakdown during operation.	Regularly grease and clean equipment. Keep logs services that may be needed.
5	Follow safety precautions for attachment change-out.	When changing out equipment attachments, attachments can fall and injure workers.	Make sure equipment is grounded before disconnecting hoses. Stand to side of attachment when pulling main pin. Keep all body parts out from under suspended loads and attachments.

Heavy Equipment Operation

	Job Steps	Potential Risks	Critical Actions
1	Use spotters and establish work safety zones.	Personnel may be injured if in line of fire or struck by equipment (if in swing radius) or flying debris. Flying debris can cause equipment and property damage.	Use spotters if possible. Enforce work safety zones according to manufacturer specifications for each attachment (e.g., danger tape, barricades, signs, and markers). Use spotters if physical barriers are not realistic.
2	Follow safety precautions for sharp objects.	Sharp objects can cause equipment damage such as flat tires or torn hoses.	When using sheer, stockpile material to a safe area or a scrap metal bin. When using breaker attachment, barricade or mark area to restrict access to operation.
3	Keep away from live systems.	Line strike can cause property damage or serious injury.	Have spotters keep equipment 3 -ft. away from live systems and 6 -ft. away when sheering.

4	Use proper equipment for job and take precautions to avoid rolling over.	Equipment can roll over due to loss of control or unstable surfaces.	Use right equipment for job/level equipment before operating. Wear seat belt at all times. Check out-rigger footing before using backhoe attachments.
5	Use Confined Space Entry permit and precautions if needed.	Cave-in or trench engulfment can result in serious injury or death.	Excavations over 4 ft. require a Confined Space Entry permit. Use proper shoring, shielding and sloping if entry is required. Refer to OSHA regulations. **IDLH**
Equipment Shutdown			
	Job Steps	**Potential Risks**	**Critical Actions**
1	Shut down equipment properly and completely.	Improper shutdown of equipment may cause engine damage or loss of control while equipment s unattended.	Take equipment out of gear when at a complete stop. Engage emergency brake and turn key to OFF position. Ground all attachments and move levers to bleed system.
2	Barricade job site before leaving.	Open holes left after digging can result in injury if personnel fall in holes or trenches.	Barricade job site with snow fencing or barricade tape or cover with a trench plate before leaving job site for any reason.
Post-work Equipment Inspection			
	Job Steps	**Potential Risks**	**Critical Actions**
1	Use three points of contact and do not climb on outer shell.	Personnel can fall when climbing steps or ladders.	Use three points of contact on steps and ladders. Do not climb on outer shell. Use harness with lanyards above 6 ft.
2	Use proper hand and body placement.	Doors and hoods present pinch points.	Use proper hand and body placement. Use handles provided.
3	Remove unsafe equipment from service for repair.	Faulty equipment, hoses or fittings can cause spills or injuries.	Remove any unsafe equipment from service and have repaired before next use.
Equipment Decontamination and Cleanup			
	Job Steps	**Potential Risks**	**Critical Actions**
1	Clean up any oil, solids, trash or debris.	Leaving oil, solids, trash or debris on or around backhoe can cause environmental issues or fines.	At the end of each shift, clean up any oil, solids, trash or debris on or around the backhoe.
2	Decontaminate hazardous materials and equipment.	Improper decontamination or cleaning of equipment could potentially contaminate soil.	Decontaminate any hazardous materials on equipment in designated decontamination area. Consult with the site's Environmental contact.

Site-Specific Hazards that Require Action	
Potential Risks	**Critical Actions**

Date:_____ Emergency #:_____Time:_____ Supervisor:_____

	Name Time	Name Time	Name Time
In			
Out			

**Your signature above indicates that you are aware of your responsibility to report any illness, injury or fatigue issues to your Supervisor.*

Job Loss Analysis

Loss Prevention System™
An integrated process to maximize business performance

Minimum Personal Protective Equipment (PPE)

☐ Goggles	☐ Safety Back Belt	☐ Safety Cones	☐ Welding Hood
☐ Face Shields	☐ Hearing Protection	☐ Warning Device	☐ Gloves _____
Safety Glasses	Hard Hat	Tagout/Lockout Kit	Other _____
☒	☒ Safety Shoes	Hi-Viz Jacket	Other _____
	☒	☐	☐
		☐	☐

Job Site and Equipment Inspection

	Job Steps	Potential Risks	Critical Actions
1	Employees fit for duty.	EEs working while not physically, mentally, or emotionally fit could cause equipment damage or personal injury.	Supervisor should evaluate EEs for mental, physical, and emotional fitness before and during work. Remove EE if concerned.
2	Use qualified employees	Employees on job site not qualified for the job can cause loss time till switch out of workers.	Insure all employees are trained and qualified to perform their job duties.
3	Have enough equipment	A shortage of equipment and supplies will delay the job.	Make sure to bring the proper amount of fresh air, lifelines, masks, harnesses, five minute packs, and PPE required for the number of employees and distance of work being performed.
4	Inspect equipment	Using damaged equipment on job site could cause delays, injury or death to employees.	Inspect all equipment. Check for cracks, cuts, and damaged fittings on hoses, seal and frame on masks, for tears on harnesses.
5	Upgrade PPE as needed	Not using the required PPE can result in injury to employee.	Read SDS for the product you are handling so you know what PPE you need to upgrade when performing work under fresh air.
6	Inspect air bottles	Using empty bottles or bottles with lower grade air could cause injury or fatality	Check to be sure all air bottles are full. Check content of bottles with 4 gas meter to ensure Grade D breathing air.
7	Check if employees can wear air masks	Employees not fit tested or clean shaven could cause personal injury.	Insure fit testing is current for employees going under fresh air. All employees must be clean shaven at the beginning of each shift.

Job Set Up

	Job Steps	Potential Risks	Critical Actions
1	Set up air hoses	Running air lines too far could cause lack of air to get to employees causing injury or fatality.	Never run more than 300 feet of breathing air hose per OSHA guidelines.
2	Set up life line	Not using a lifeline is a deviation of PSC policies. Not having lifelines could hinder rescue and employee locating in case of an emergency.	Stretch out and connect hoses. Tape lifeline to hoses to avoid tangling. Tape together every 2 feet. Each employee should have his own lifeline.
3	Set up air bottles	Uneven surface can cause the air bottles to roll and shift causing them to fall and damage air bottles, equipment or injure employees.	Insure air bottles are on stable and flat surface.
4	Pressure test hoses	Hoses with holes will cause a loss of air resulting in running out of air or injury.	After everything is setup pressure test equipment before start up.

Working Under Fresh Air

	Job Steps	Potential Risks	Critical Actions
1	Avoid Kinking of hoses	Kinked hose will cut off air supply causing employee to not be able to breath.	When under fresh air always watch your hoses to insure they are not tangling or kinking up on equipment. If this happens turn on 5 min. escape pack and exit the

			work zone. After a 5 min. pack has been used it must be switched out for a fully charged bottle. Follow this action whenever you have a cut off of air.

2	Monitor Bottles	Bottle watch not monitoring the bottles for air pressure will cause employees to be short of air which could cause employees to rush out of the work zone or personal injury.	Bottle watch must be trained for the job. Some clients require proof of certification on employee. Bottle watch should always monitor bottles and pull out employees before they run out of air.
3	Follow confined space procedures	Other hazards will apply when working in a confined space that can result in injury or death to employees.	Employees are to refer to the Confined space JLA for additional steps, potential risk and critical Actions.
4	Barricade job site	Other workers not aware of our work can be exposed to hazards in the work zone resulting in injury or death.	Barricade the job site with red fresh air tape.
Job Completion and Tear Down			
Job Steps		**Potential Risks**	**Critical Actions**
1	Account for all equipment	Leaving equipment on job site will result in loss of equipment.	Inventory all equipment to insure all is accounted for.
2	Decon equipment	Not cleaning equipment will cross contaminate and damage equipment.	Clean all equipment before returning to yard.
3	Inspect equipment for damage	Returning damaged equipment can delay the next crew that needs it.	Always inspect equipment for damages before returning and insure all bottles are fully charged.
4	Disconnecting air hoses	When disconnecting hose under pressure hoses can whip injuring employee.	Always hold the end of the female connection and point the connection down and away from you when disconnecting by pulling back the fitting.

Site-Specific Hazards that Require Action	
Potential Risks	**Critical Actions**

Date:_____ Emergency #:_____ Time:_____ Supervisor:_____

	Name Time	Name Time	Name Time
In			
Out			

**Your signature above indicates that you are aware of your responsibility to report any illness, injury or fatigue issues to your Supervisor.*

BLOOD BORNE PATHOGENS INCIDENT EVALUATION FORM

Employee Name: _____
Office/Location: _____
Date: _____ Time: _____ a.m./p.m.

Circumstances: Supervisor's Assessment of the Following Control Measures Used at the Time of the Exposure (see definition below):

Route of Exposure: _____
_____
_____

Engineering: _____
_____
_____

Work Practice: _____
_____
_____

Personal Protective Equipment: _____
_____
_____

Reason for Failure of the Control Measures or Failure to Comply with Recommended Protective Measures:
_____
_____
_____

Measures Taken to Minimize Reoccurrence of Incident:_____
_____
_____
_____

Supervisor's Signature: _____

Definitions:

Exposure Incident: a specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that result from the performance of an employee's duties.

Engineering Controls: controls (e.g., sharps, disposal containers, self-sheathing needles) that isolate or remove the blood borne pathogens hazard from the workplace.

Work Practice Controls: controls that reduce the likelihood of exposure by altering the manner in which a task is performed (e.g., prohibiting recapping of needles by a two-handed technique).

Personal Protective Equipment is specialized clothing or equipment worn by an employee for protection against a hazard. General work clothes not intended to function as protection against a hazard are not considered to be personal protective equipment.

UNIVERSAL PRECAUTIONS FOR BLOODBORNE PATHOGENS

"Universal Precautions" Universal Precautions is an approach to infection control in which all human blood and certain human body fluids are treated as if known to be infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV) and other bloodborne pathogens.

How is HIV Transmitted?

1. Sexual intercourse with an infected person.
2. Direct blood-to-blood transfer (e.g., sharing intravenous needles with an infected person, transfusion with infected blood or blood products).
3. Infected mother to unborn child.

HIV and HBV ARE NOT TRANSMITTED THROUGH CASUAL CONTACT.

What body fluids are important with Universal Precautions?

1. Blood and any body fluid that is visibly contaminated with blood.
2. Semen, vaginal secretions, cerebrospinal fluid (around brain and spinal column), synovial fluid (joints), pleural fluid (lungs), pericardial fluid (heart), peritoneal fluid (abdomen), amniotic fluid (fetus in womb), saliva in dental procedures.
3. Concentrated HIV or HBV (in the laboratory or research setting).

What are the principles of Universal Precautions?

1. "Barrier". Use appropriate barrier precautions to prevent skin and mucous membrane exposure to infectious body fluids. These may include: gloves (latex or vinyl), masks, goggles, gowns or aprons. Gloves should be worn for any contact with blood or infectious body fluids. Change gloves if they are torn. Do not reuse single-use gloves. Utility gloves may be disinfected and reused. Pocket masks for performing rescue breathing/CPR may be used. Some masks may be disinfected and reused.

2. "Wash Hands". Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood or other body fluids. Soap and water or antiseptic hand cleanser should be used. Wash hands immediately after removing gloves.

3. "Prevent Injuries". Put used needles and sharp instruments directly into puncture-resistant containers that are readily available. Never re-cap, bend or break a needle by hand.

4. "Clean Up". Any surface or object that is contaminated with blood or infectious body fluids should be cleaned promptly. Decontaminate surfaces with an appropriate disinfectant. Household bleach mixed at a ratio of 1 part bleach to 100 parts water (one quarter cup bleach in one gallon water) is recommended. Thoroughly wash and disinfect reusable items or instruments. Dispose of infectious waste by placing in closable, leak proof containers. Infectious waste for disposal should be clearly labeled "BIOHAZARD". Disposal is according to applicable federal, state and local regulations.

PSC
AIR MONITORING DATA FORM

PROJECT NAME: _____ INSTRUMENT USED: _____
PROJECT NUMBER: _____ SAMPLES BY: _____
DATE: _____ CALIBRATION DATE: _____

FIELD ACTIVITIES:
_____

BACKGROUND LEVEL: _____ LOCATION: _____

SAMPLE NUMBER	TIME	DURATION (MINUTES)	LOCATION	READING (PPM)	COMMENTS
1					
2					
3					
4					
5					
6					
7					

PSC
EQUIPMENT CALIBRATION LOG FORM

PROJECT NAME: _____ INSTRUMENT: _____
PROJECT NUMBER: _____ SERIAL NUMBER: _____

DATE	CALIBRATED BY	HOURS USED	CALIBRATION STANDARD *	INITIAL READING *	CORRECTED READING *	BATTERY CHECK (Y/N)	MAINTENANCE AND REPAIR

*Specify Units

APPENDICES

DECONTAMINATION

Standard Procedures

1 A decontamination area should be located between the Hot Line (upwind boundary of the Exclusion Zone) and the Support Zone boundary.

2 A personnel decontamination station (PDS) should be established.

3 All personnel should proceed through the appropriate contamination reduction sequence upon leaving the contamination area.

4 All protective gear should be left on site during any lunch break following decontamination procedures.

5 Safety Data Sheets for chemicals used during decontamination procedures should be made available to those who are potentially exposed to these chemicals and should be attached to this health and safety plan.

Decontamination of Equipment

Heavy equipment will be decontaminated within the drum and/or impacted soils containment areas upon completion of excavation activities or when it is necessary for equipment to exit the exclusion zone. To the extent possible, measures should be taken to prevent contamination of sampling and monitoring equipment. Sampling devices may become contaminated; however, monitoring instruments, unless they are splashed, usually do not become contaminated. Once contaminated, it is difficult to clean instruments without damaging them. Any delicate instrument that cannot be decontaminated easily should have a bag taped and secured around it. Openings should be made in the bag for sample intake.

Sampling Devices

Sampling devices require special cleaning. Decontamination of all sampling equipment should be performed using an appropriate solvent or detergent followed by a clean water rinse.

Tools

Wooden tools are difficult to decontaminate because they absorb chemicals. They should be kept on site and handled only by protected workers. After use in a contaminated area, wooden tools should be discarded. For decontaminating other tools, an appropriate detergent or solvent should be used followed by a clean water rinse.

Respirators

Certain parts of contaminated respirators, such as the harness assembly and cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. Persons responsible for decontaminating respirators should be thoroughly trained in respirator maintenance.

Heavy Equipment
Bulldozers, trucks, backhoes, bulking chambers, and other heavy equipment are difficult to decontaminate. Generally, they are washed with water under high pressure and/or accessible parts are scrubbed with detergent/water solution under pressure, if possible. In some cases, shovels, scoops, and lifts have been sand blasted or steamed. As necessary, heavy equipment will be decontaminated within the drum and/or impacted soils containment areas upon completion of excavation activities or when it is necessary for equipment to exit the exclusion zone. Care must be given to those components in direct contact with contaminants, such as tires and scoops.

Tractor-trailer, tandem, and roll-off truck traffic is expected to stay on the access roads, therefore minimizing the need for decontamination of trucks. In the event it is necessary to move trucks off the access roads, basic decontamination will be performed and tires scrubbed as necessary before leaving site. All trucks exiting the site will be tarped or covered in some fashion before exiting.

Sanitizing of Personal Protective Equipment
Respirators, reusable protective clothing, and other personal articles not only must be decontaminated before being reused, but also must be sanitized. The inside of masks and clothing becomes soiled because of exhalation, body oils, and perspiration. The manufacturer's instructions should be followed to sanitize the respirator mask. If practical, protective clothing should be machine washed after a thorough decontamination; otherwise, it must be cleaned by hand.

Persistent Contamination
In some instances, clothing and equipment will become contaminated with substances that cannot be removed by normal decontamination procedures. A strong detergent (industrial grade) may be used to remove such contamination from equipment if it does not destroy or degrade the protective material. If persistent contamination is expected, disposable garments should be used.

Disposal of Contaminated Materials
All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be secured in drums or other containers and labeled. Clothing not completely decontaminated on site should be secured in plastic bags before being removed from the site. Contaminated wash and rinse solutions should be contained by using step-in-containers (e.g., child's wading pool) to hold spent solutions. Another containment method is to dig a trench about 4 inches deep and line it with plastic. In both cases, the spent solutions should be transferred to drums, which should be labeled and disposed of with other substances on site.

Minimal Decontamination
Less extensive procedures for decontamination can be subsequently established when disposable clothing and equipment are used, the type and degree of contamination become known, or the potential for transfer is judged to be minimal by the Site Safety Coordinator in consultation with the Project Manager.

Closure of the Personnel Decontamination Station
All disposable clothing and plastic sheeting used during the operation should be double bagged, labeled, and either contained on site or removed to a client-approved disposal facility. Grossly contaminated protective clothing should be disposed of on site with the permission of the property owner. Cloth items should be bagged and removed from the site for final cleaning. All wash tubs, pails, containers, etc., should be thoroughly washed, rinsed, and dried prior to removal from the site.

HEAT STRESS/COLD STRESS

Cold Stress

If site work is to be conducted during the winter, cold stress is a concern to the health and safety of personnel. With regard to the wearing of Tyvek suits, because such disposal clothing does not "breathe," perspiration does not evaporate and the suits can become wet. Wet clothes combined with cold temperatures can lead to hypothermia. If the air temperature is less than 40 degrees Fahrenheit (□F) and an employee perspires, the employee must change to dry clothes. The attached table, Signs and Symptoms of Cold Stress, describes the signs and symptoms of cold stress.

Heat Stress

Wearing PPE also puts a worker at a considerable risk of developing heat stress. The attached table, Signs and Symptoms of Heat Stress, describes the signs and symptoms of heat stress. This can result in health effects ranging from heat fatigue to serious illness or death. Consequently, regular monitoring and other precautions are vital.

For workers wearing standard work clothes, recommendations for monitoring and work/rest schedules are those approved by ACGIH and NIOSH. Workers wearing semi-permeable PPE or impermeable PPE should be monitored when the temperature in the work area is above 70□F. To monitor the worker, the following should be measured:

- Heart rate--The radial pulse should be counted during a 30-second period as early as possible in the rest period.
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle should be shortened by one third and the rest period should be kept the same.
  - If the heart rate still exceeds 110 beats per minute at the next rest period, the following work cycle should be shortened by one third.
- Oral temperature--A clinical thermometer (3 minutes under the tongue) or similar device should be used to measure the oral temperature at the end of the work period (before drinking).
  - If the oral temperature exceeds 99.6ºF (37.6 degrees Celsius (ºC)), the next work cycle should be shortened by one third, without the rest period being changed.
  - If the oral temperature still exceeds 99.6□F (37.6□C) at the beginning of the next rest period, the following work cycle should be shortened by one third.
  - A worker should not be permitted to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6□F (38.1□C).

Initially, the frequency of monitoring depends on ambient temperature (see attached table, Suggested Frequencies of Physiological Monitoring for Fit and Acclimatized Workers). The length of the work cycle is determined by the frequency of physiological monitoring described above.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important, because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, the following steps should be taken:

- Work schedules should be adjusted.

- Shelter (air-conditioned, if possible) or shaded areas should be provided to protect personnel during rest periods.

- Workers' body fluids should be maintained at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat--i.e., 8 fluid ounces (0.23 liter) of water must be ingested for approximately every 8 ounces (0.23 kilogram) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, the worker should be encouraged to drink more. The following strategies may be useful:

1 Water temperature should be maintained at 50ºF to 60ºF (10º to 15.6ºC).
2 Small disposable cups that hold about 4 ounces (0.1 liter) should be provided.

SIGNS AND SYMPTOMS OF COLD STRESS

Incipient frostbite is a mild form of cold stress characterized by sudden blanching or whitening of the skin.

Chillblain is an inflammation of the hands and feet caused by exposure to cold moisture. It is characterized by a recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears. Such a sequence produces severe spasms, accompanied by pain.

Second-degree frostbite is manifested by skin with a white, waxy appearance and the skin is firm to the touch. Individuals with this condition are generally not aware of its seriousness, because the underlying nerves are frozen and unable to transmit signals to warn the body. Immediate first aid and medical treatment are required.

Third-degree frostbite will appear as blue, blotchy skin. The tissue is cold, pale, and solid. Immediate medical attention is required.

Hypothermia develops when body temperature falls below a critical level. In extreme cases, cardiac failure and death may occur. Immediate medical attention is warranted when the following symptoms are observed:

- Involuntary shivering
- Irrational behavior
- Slurred speech
- Sluggishness.

SIGNS AND SYMPTOMS OF HEAT STRESS

Heat rash may result from continuous exposure to heat or humid air.

Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- Muscle spasms
- Pain in the hands, feet, and abdomen.

Heat exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, and moist skin
- Heavy sweating
- Dizziness, fainting, and nausea.

Heat stroke is the most serious form of heat stress. Temperature regulation fails, and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Competent medical help must be obtained. Signs and symptoms are:

- Red, hot, and unusually dry skin
- Lack of or reduced perspiration
- Dizziness and confusion
- Strong, rapid pulse, and coma.

Have workers drink 16 ounces (0.5 liter) of fluid (preferably water or diluted drinks) before beginning work. Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight. Weigh workers before and after work to determine if fluid replacement is adequate.

Encourage workers to maintain an optimal level of physical fitness. Where indicated, acclimatize workers to site work conditions.

Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure.

Train workers to recognize, identify, and treat heat stress.

TABLE

SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATIZED WORKERS [b]

Adjusted Temperature	Normal Work Ensemble	Impermeable Ensemble
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

[a]Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = °F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent of the time the sun is not covered by clouds that are thick enough to produce a shadow (100% sunshine = no cloud cover and a sharp, distinct shadow; 0% sunshine = no shadows).
[b]For work levels of 250 kilocalories/hour.
[c]A normal work ensemble consists of cotton overalls or other cotton

TOXIC SNAKE AND INSECT BITES AND PLANTS

Poisonous Snakebites

General

Reactions from snakebite are aggravated by acute fear and anxiety. Other factors that affect the severity of local and general reaction from poisonous snakebite include: the amount of venom injected and the speed of absorption of venom into the victim's circulation; the size of the victim; protection from clothing, including shoes and gloves; quick antivenin therapy; and location of the bite.

First Aid Procedure

The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration.

The most important step is to get the snakebite victim to the hospital quickly. Meanwhile, take the following first aid measures:

1. Keep the victim from moving around.

2. Keep the victim as calm as possible and preferably in a lying position.

3. Immobilize the bitten extremity and keep it at or below heart level. If the victim can reach a hospital within 4 to 5 hours and if no symptoms develop, no further first aid measures need be applied.

4. If mild-to-moderate symptoms develop, apply a constricting band 2 to 4 inches above the bite, but not around a joint (the elbow, knee, wrist, or ankle) and not around the head, neck, or trunk. The band should be 3/4 to 1 1/2 inches wide, not thin like a rubber band. The band should be snug but loose enough for a finger to be slipped underneath. Watch out for swelling. Loosen the band if it becomes too tight, but do not remove it. Periodically check the pulse in the extremity beyond the bite to insure that the blood flow has not stopped.

5. If severe symptoms develop, make an incision and apply suction immediately. Apply a constricting band, if this has not already been done, and make a cut in the skin through the fang mark(s). Use a sharp, sterilized knife. Cuts should be 1/2 inch long, extending over the suspected venom deposit point. (Because a snake strikes downward, the deposit point is usually lower than the fang mark.) Cuts should be made along the long axis of the limb. Do not make cross-cut incisions. Do not make cuts on the head, or trunk. Apply suction with a suction cup for 30 minutes. If a suction cup is not available, use the mouth. There is little risk to the rescuer who uses his mouth, but it is recommended that the venom not be swallowed and that the mouth be rinsed out.

If the hospital is not close, that is, if it cannot be reached in 4 or 5 hours, take the following measures:

- Keep trying to obtain professional care, either by transporting the victim to a place where medical care is available or by using an emergency communications system to obtain medical advice.

- If no symptoms develop, keep trying to reach the hospital and give the general first aid described above.

- If any symptoms at all develop, apply a constricting band, make incisions, and apply suction immediately, as described above in steps 4 and 5.

Several other factors must be considered in cases of snakebite:

- Shock. Keep the victim lying down and comfortable, and maintain his or her body temperature.

- Breathing and heartbeat. If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so.

- Identifying the snake. If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.

- Cleaning the bitten area. You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.

- Medicine to relieve pain. Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Some painkillers, however, may be given. Consult a doctor or other medical personnel for specific medications that may be used.

- Snakebite kits. Keep a kit accessible for all outings in primitive areas or areas known or suspected to snake infested.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snakebite.

Other Poisonous Bites

Spiders

Spiders in the United States are generally harmless, with two notable exceptions: the Black Widow spider (Latrodectus Mactans) and the Brown Recluse or violin spider (Lox Osceles Reclusa).

The symptoms of a Black Widow spider bite are: slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in breathing and speaking. Victims recover in almost all cases, but an occasional death is reported. The bite of a Black Widow spider is the more painful and often the more deadly of the two.

Field personnel should exercise caution when lifting covers off manholes or sumps, or rummaging through wood, rock, or brush piles, etc. since both the Black Widow and Brown Recluse spiders can typically be found in these areas.

Scorpions

Scorpions inject venom through a stinger in the tail. In bites from the more dangerous species, there are marked systemic effects within 1 to 2 hours. Fatalities have been recorded.

The symptoms of a scorpion bite are: excruciating pain at the site of the sting, nausea and vomiting, abdominal

pain, shock, and possible development of convulsions and coma.

General First Aid for Poisonous Insect Bites:

- Minor Bites and Stings

  - Cold applications.
  - Soothing lotions, such as calamine.

- Severe Reactions

  - Give artificial respiration if indicated.
  - Apply a constricting band above the injection site on the victim's arm or leg (between the site and the heart). Do not apply tightly. You should be able to slip your index finger under the band when it is in place.
  - Keep the affected part down, below the level of the victim's heart.
  - If medical care is readily available, leave the band in place; otherwise, remove it after 30 minutes.
  - Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting or bite.
  - Give home medicine, such as aspirin, for pain.
  - If the victim has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if he or she is not promptly relieved of symptoms, call a physician or take the victim immediately to the nearest location where medical treatment is available. In a highly sensitive person, do not wait for symptoms to appear, since delay can be fatal.
  - In case of a bee sting, remove and discard the stinging apparatus and venom sac.

Tickborne Diseases

Lyme Disease

Lyme disease is an illness caused by a bacterium which may be transmitted by the bite of a tick (Ixodes Dammini), commonly referred to as the "Deer Tick". The tick is about the size of a sesame seed, as distinguished from the Dog Tick, which is significantly larger. The Deer Tick is principally found along the Atlantic coast, living in grassy and wooded areas, and feeds on mammals such as mice, shrews, birds, raccoons, opossums, deer, and humans. Not all ticks are infected with the bacterium, however. When an infected tick bites, the bacterium is passed into the bloodstream of the host, where it multiplies. The various stages and symptoms of the disease are well recognized and, if detected early, can be treated with antibiotics.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, but not firmly, until it releases its hold on the skin. Save the tick in a jar labeled with the date, body location of the bite, and the place where it may have been acquired. Wipe the bite thoroughly with an antiseptic and seek medical attention as soon as possible.

The illness typically occurs in the summer and is characterized by a slowly expanding red rash, which develops a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage treatment by a physician is usually effective; but, if left alone, these early symptoms may disappear and more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems which may occur include meningitis and neurological and cardiac abnormalities. It is important to note that some people do not get the characteristic rash but progress directly to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

When in an area suspected of harboring ticks (grassy, bushy, or woodland area) the following precautions can

minimize the changes of being bitten by a tick:

1. Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists.
2. Wear light colored clothing so ticks can be easily spotted.
3. Wearing tick repellents may be useful.
4. Inspect clothing frequently while in tick habitat.
5. Inspect your head and body thoroughly when you return from the field.
6. Remove any attached ticks by tugging with tweezers where the tick's mouth parts enter the skin. Do not squeeze or crush it.

Rocky Mountain Spotted Fever

In the eastern and southern United States this tickborne disease is transmitted by the infected Dog Tick (Dermacentor Variabilis). It is important to note that the Dog Tick is significantly larger than the Deer Tick. Nearly all cases of infection occur in the spring and summer, generally several days after exposure to infected ticks. The onset of illness is abrupt and often accompanied by high fever, headache, shills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash that usually starts on the hands and feet and gradually extends to most of the body. As with Lyme disease, early detection and treatment significantly reduces the severity of illness. The disease responds to antibiotic therapy with tetracycline or chloramphenicol.

Other Tickborne Diseases

Ticks transmit several other diseases, most of which are rare and occur only in specific areas. Babesiosis occurs mainly in the Cape Cod area and eastern Long Island. Colorado tick fever is similarly regional and occurs only among those who live or work at altitudes above 4,000 feet.

Poisonous Plants

Characteristic Reactions

The majority of skin reactions following contact with offending plants are allergic in nature and are characterized by general symptoms of headache and fever, itching, redness, and a rash.

Some of the most common and most severe allergic reactions result from contact with plants of the Poison Ivy group including Poison Oak and Poison Sumac. the most distinctive features of poison ivy and Poison Oak are their leaves, which are composed of three leaflets each. Both plants also have greenish-white flowers and berries that grow in clusters. Such plants produce a severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may be delayed for 24 to 48 hours.

First Aid Procedure

1. Remove contaminated clothing.
2. Wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.
3. Apply calamine or other soothing skin lotion if the rash is mild.
4. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

Prepared for

Stratus Redtail Ranch, LLC

HEALTH AND SAFETY PLAN

Neuhauser Landfill,

Weld County, Colorado

Prepared by

Geosyntec consultants

engineers | scientists | innovators

5670 Greenwood Plaza Blvd. Suite 540
Greenwood Village, CO 80111

Project Number: DE0302

5 December 2017

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H&S INCIDENT RESPONSE PRODECURES

CHOOSE THE RIGHT PATH

Life-Threatening Emergency → **Immediately dial 911 or the local emergency number** → **Transport to medical facility** → **Notify H&S team** → **Notify your manager** → **Manager completes and files Incident Report within 24 hours**

Non Life-Threatening Incident or Emergency → **Notify your manager and the H&S team** → **If H&S team cannnot be reached, notify WorkCare, 888-449-7787** → **H&S or WorkCare will help determine the appropriate level of care** → **Seek out care or apply first aid**

Near Miss Incident → **File Near Miss Report within 24 hours**

For more Information:
All work-related injuries, illnesses, and near-miss situations, to include vehicle accidents and general liability claims, must be documented and reported to the Health and Safety (H&S) team

Visit the H&S team on the intranet:
http://home.geosyntec.com/Corp/EHS/.

Dale Prokopchak
804-349-8067

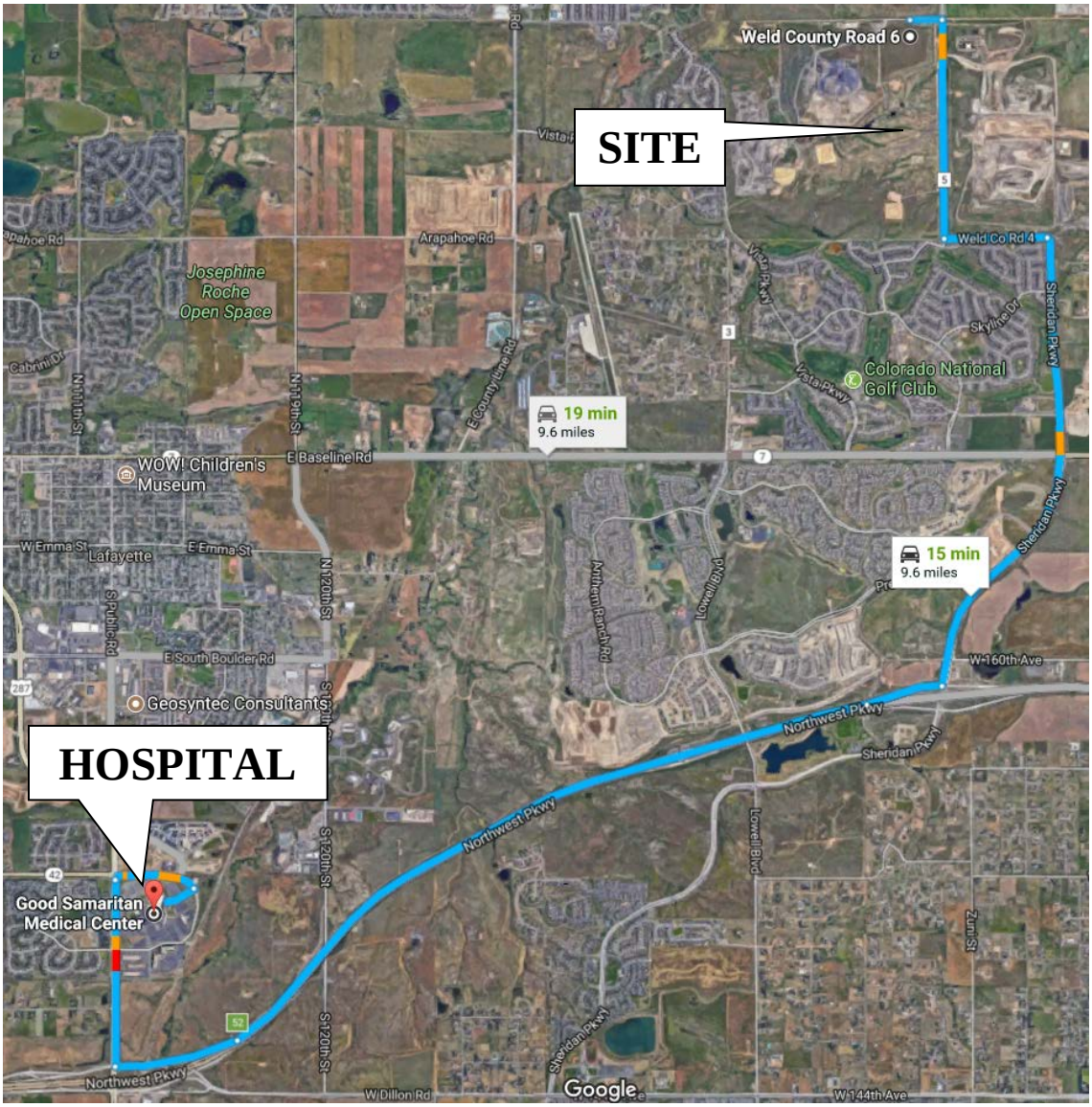
West Region

Ersin Yalcin
404-435-4722
Southern Region

Mark Malchik
781-392-5440
North Region

Geosyntec consultants

ROUTE TO HOSPITAL



Geosyntec consultants

Good Samaritan Medical Center

303-689-4000

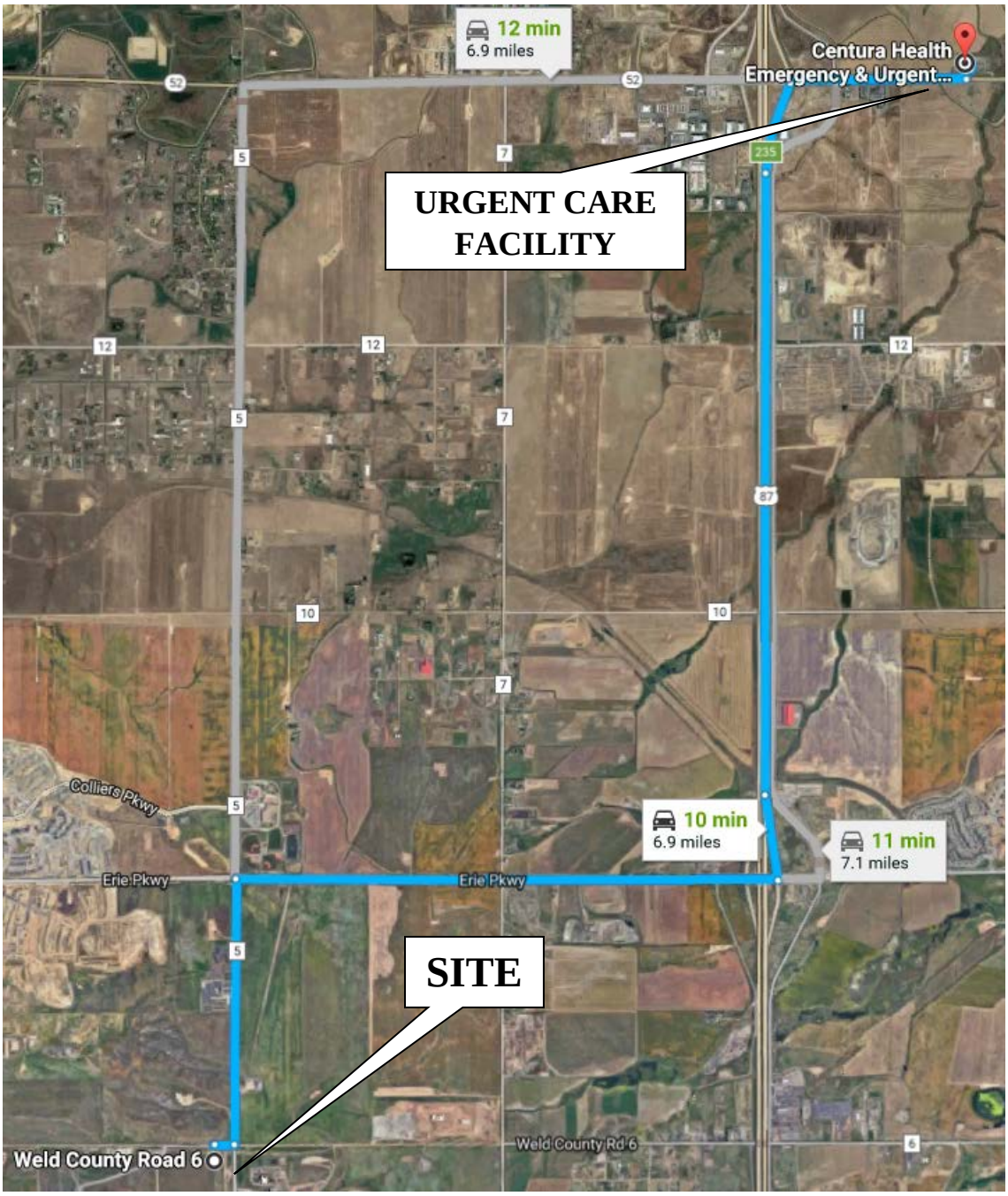
200 Exempla Circle

Lafayette, CO 80026

DIRECTIONS TO HOSPITAL FROM SITE

- Head south on Co Rd 5
- Turn left onto Weld Co Rd 4 (0.5 mi.)
- Weld Co Rd 4 turns right and becomes Sheridan Pkwy (2.3 mi.)
- Turn right onto the ramp and merge onto the Northwest Pkwy W (3.8 mi.)
- Take exit 52 to merge onto W Dillon Rd toward US-287/Lafayette/Broomfield (0.6 mi.)
- Turn right onto S 112th St (0.9 mi.)
- Turn right onto Exempla Cir (0.4 mi.)
- Hospital is on the right

ROUTE TO URGENT CARE FACILITY



Centura Health Emergency & Urgent Care - Frederick

(303) 925-4840

4943 Highway 52, Suite 100

Frederick, CO 80514

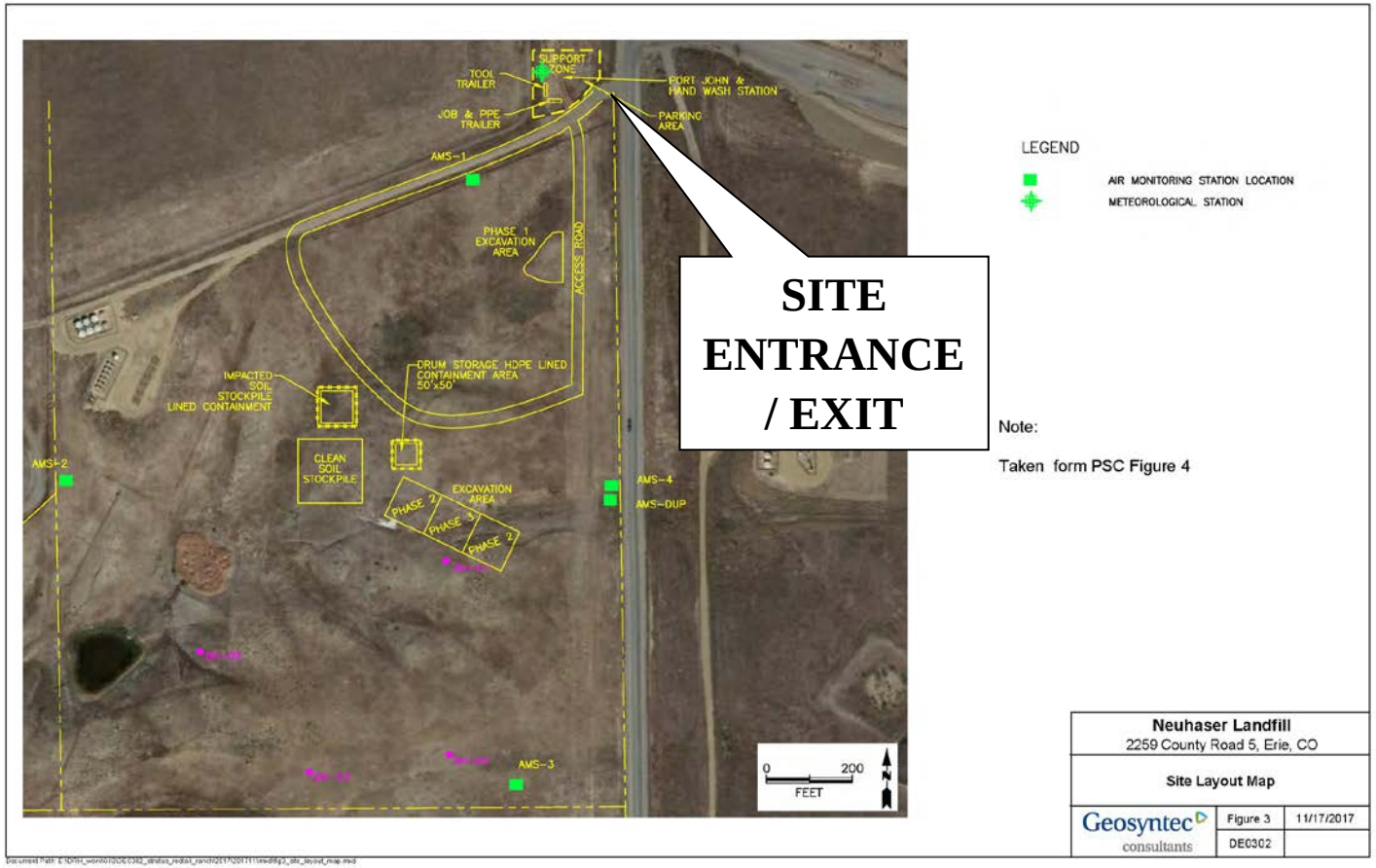
Note – Urgent care open 7 AM – 9 PM, Emergency care open 24/7.

DIRECTIONS TO URGENT CARE FACILITY FROM SITE

- Head north on Co Rd 5 (1 mi.)
- Turn right onto Erie Pkwy/Weld County Rd. 8 (2.0 mi.)
- Turn left onto Interstate 25 N ramp and merge onto I-25 (2.7 mi.)
- Take exit 235 for CO-52 toward Dacono/Ft. Lupton (0.4 mi.)
- Turn right onto CO-52 E/State Hwy 52 E (0.7 mi.)
- Urgent Care is on the left

Geosyntec consultants

SITE MAP



1. INTRODUCTION

This site-specific Health and Safety Plan (HASP) was prepared to address project-specific hazards known or suspected to be present associated with the existing conditions and work to be performed at the work site under Administrative Settlement Agreement and Order on Consent Docket Number CERCLA-08-2018-0002. This HASP was prepared to meet the requirements specified in Occupational Safety and Health (OSHA) Hazardous Waste Operations Emergency and Response (HAZWOPER) program, Geosyntec Consultants, Inc. (Geosyntec)'s Health and Safety (H&S) Procedure HS 301, and the H&S requirements of the client.

2. SIGNATURES

2.1 Preparers and Reviewers

This HASP must be maintained on-site when field work is being performed. The Site Health and Safety Officer (SHSO) can change or amend this document, in agreement with the Health and Safety Coordinator (HSC) or Project Manager (PM). Amendments (e.g., changes in personal protective equipment, addition of tasks, etc.) must be documented in Section 19 and in Appendix A. This HASP must be reviewed and amended on an annual basis for projects lasting more than one year.

Prepared by:		12/5/2017
	SHSO	Date
Reviewed by:		12/5/2017
	HSC	Date
Approved by:		12/5/2017
	PM	Date

This HASP has been given to the following H&S approved subcontractor(s).

Subcontractor	Representative	Date
Subcontractor	Representative	Date
Subcontractor	Representative	Date

2.2 Site Workers

This HASP must be reviewed by personnel prior to site work. Workers not in attendance at the initial meeting must be trained by the SHSO on the information covered in the pre-entry briefing. After reading the HASP and attending a pre-entry briefing, Geosyntec employees and other parties covered under this HASP must sign the following acknowledgment statement.

"I have read, understand, and will perform my work in accordance with the information set forth in this HASP."

Signature	Printed Name	Date

3. EMERGENCY CONTACT INFORMATION

Contact	Telephone Numbers	
	Office	Alternate (Type)
Fire Department – Lafayette FD Station #1 - North Metro Fire & Rescue Station 66	(303) 665-9661 (303) 452-9910	911 (Emergency)
Police Department – Erie PD	(303) 926-2800	911 (Emergency)
Site Emergency Response (if applicable)		
Hospital – Good Samaritan Medical Center	(303) 689-4000	911 (Emergency)
Director of H&S – Dale Prokopchak	(804) 332-6376	(804) 349-8067 (Cell)
H&S Regional Manager – Dale Prokopchak	(804) 332-6376	(804) 349-8067 (Cell)
Project Manager – Tom Krasovec	(720) 509-8911	(517) 719-4984 (Cell)
Site Health & Safety Officer – Jackie Rowley/ Patrick Medland	(720)509-8924/(720) 509-8907	(331)308-3653/(517) 242-0515 (Cell)
H&S Coordinator – Patrick Medland	(720) 509-8907	(517) 242-0515 (Cell)
Principal-in-Charge – Dave Folkes	(720) 509-8913	(720) 560-1707 (Cell)
Utility Emergencies –	811	
Work Care –	(888) 449-7787	(714) 978-7488
Facility Contact – NA		
Client Contact – Richard Dean, Manager	720-214-5000	

Client's Contractor – ACTenviro – Tobi Moore	303-517-8815	
ACT's Subcontractor – PSC Now – Jacob Blanton Project Manager	888-449-7787	
Jarrod Moore, Site Manager	732-321-6660	

4. APPLICABILITY OF THIS HASP

This HASP was prepared in accordance with Geosyntec's H&S Procedures for use by Geosyntec project staff and subcontractors. Subcontractors, at a minimum, shall ensure that their employees, and those of its lower tier subcontractors, comply with these procedures and other health, safety and security provisions in the Subcontract. Compliance with this HASP shall represent the minimum requirements to be met by subcontractors, who shall be responsible for examining all requirements and determining whether additional or more stringent health, safety and security provisions are appropriate for their portion of the work and implementing them accordingly. Therefore, for firms executing all or any portion of the work, this document and its contents should not be used without a thorough peer review by their health and safety managers. Prior to commencing work, such firms are responsible for reviewing and supplementing the HASP to add appropriate procedures specific to their portion of the work required by OSHA or other agency having jurisdiction (heavy equipment operation, trench safety, lock-out tag out, etc.), should be met in the individual site specific HASP prepared by the Contractor. It is noted that ACTenviro and its subcontractors are contracted directly by the client and are not subject to compliance with this HASP. This HASP is applicable only to Geosyntec project staff and any subcontractor Geosyntec employs. In addition, this HASP is addended to the ACT HASP. Geosyntec will abide by the most strigent interpretation between the two HASPs.

5. SITE/TASK/HAZARD DESCRIPTION

5.1 Site Background

The following is a brief description of the site, including information as to the location, approximate size, previous usage, and current usage. A description of the tasks to be performed is also presented.

Site Location:	Northwest corner of Weld County Road 4 and Weld County Road 5
Approximate Size of Site:	294 acres

Previous Site Usage:	Used for oil, gas, mining, landfilling and agricultural purposes.
Current Site Usage:	Undeveloped land

Description of Surrounding Property/Population:

North:	Landfill	**East:**	Front Range Landfill
South:	Housing development and golf course	**West:**	Oil wells and Industrial

Summary of Previous Site Investigations (if available/applicable):

Previous investigations of groundwater at the site resulted in detections of the following compounds above CDPHE groundwater standards: toluene, cis-1,2-DCE, TCE, 1,1-DCE, vinyl chloride, methylene chloride, 1,4-dioxane, cadmium, lead, selenium, and nitrate/nitrite. Other detected chemicals of note: 2-butanone (MEK), PCE, and tetrahydrofuran.

There are buried drums located on site. These may be the source of the contaminants. The liquid in two excavated drums was sampled in 2017. One sample contained elevetated levels (above regulatory limits) of MEK and toluene. The second contained elevated levels of MEK, toluene, and TCE.

5.2 Task Descriptions

Task 1: Oversight of Excavation and Drum Removal and Soil Sampling

Geosyntec personnel will document drum removal and support segregation of hazardous and non-hazardous solid waste. Additionally, Geosyntec personnel will use field screening techniques to identify excavated material that may have been impacted with site COCs and collect environmental soil samples. This role will include working near an active excavation pit with operating heavy equipment. Field screening will most likely involve use of a Photo Ionization Detector (PID) and possibly field screening kits to measure drum headspace concentrations and identifiy impacted soils.. Documentation will involve note-taking, photography, and labeling. Geosyntec personnel will need to be aware of surroundings, particularly the location of the heavy machinery and excavation, and monitor air quality while donning proper PPE.

Task 2:

Task Hazard Analyses (THAs) associated with these tasks are presented in Appendix B.

5.3 Chemical Hazards

The classes of chemicals that are known or suspected to be present that may be encountered while performing site work include the following:

- Benzene, toluene, ethylbenzene, xylenes (BTEX)
- Chlorinated volatile organic compounds (VOCs)

- Hazardous metals
- Acids, bases, and cyanide have not been found but may be present.

Controls for these hazards are presented in the THAs included in Appendix B. A summary of these chemical hazards is presented in Appendix C.

5.4 Physical Hazards

The following physical hazards have been identified associated with the work to be performed and the site conditions.

- Cold stress
- Drum and container handling
- Excavation/Trenching
- Eye injury
- Hand/Foot injury
- Heavy equipment
- Lifting heavy loads
- Loud noise/Vibration
- Portable power/Hand tool
- Slips, trips, and falls

Controls for these hazards are presented in the THAs included in Appendix B.

5.5 Biological Hazards

The following biological hazards have been identified associated with the work to be performed and the site conditions.

- Biting/mauling animals (coyotes)
- Biting/stinging insects

- Lyme disease
- Rats/vermin
- Snakes

Controls for these hazards are presented in the THAs included in Appendix B.

6. GENERAL SAFE WORK PRACTICES

The following general safe work practices must be adhered to while performing site work:

- Basic personal protective equipment (PPE) shall be worn, including hard hats, safety glasses, safety-toed boots, and high-visibility vests. If conditions allow, the requirement for hard hats may be reduced with approval of the SHSO and PM where no overhead hazards exist.
- Minimize contact with impacted materials. Do not place equipment on the ground. Do not sit or kneel on potentially impacted surfaces.
- Smoking, eating, or drinking after entering the Exclusion Zone and before personal decontamination is not allowed. Employees who are suspected of being under the influence of illegal drugs or alcohol will be removed from the site. Workers taking prescribed medication that may cause drowsiness shall not operate heavy equipment and are prohibited from performing tasks where Level C or B PPE is required.
- Practice good housekeeping.
- Site personnel should keep a safe distance from all sides of the heavy equipment while it is in use. Make eye contact with equipment operators.
- Use of contact lenses is not allowed under certain hazardous working conditions, such as exposure to certain chemical vapors or dust.
- The following conditions must be observed when operating a motor vehicle:
    - Wearing of seat belts is mandatory.
    - The use of headlights is mandatory during periods of rain, fog, or other adverse weather or low-light conditions.

  - Posted traffic signs and directions from flagmen must be observed.
  - Equipment and/or samples transported in vehicles must be secured from movement.
  - The use of vehicles acquired by Geosyntec by non-Geosyntec personnel is prohibited.

- In an unknown situation, always assume the worst reasonable conditions.
- Be observant of your immediate surroundings and the surroundings of others. It is a team effort to notice and warn of dangerous situations. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
- Conflicting situations may arise concerning safety requirements and working conditions. These must be addressed and resolved rapidly by the SHSO and PM to relieve motivations or pressures to circumvent established safety policies.
- Unauthorized breaches of specified safety protocol are not allowed. Workers unwilling or unable to comply with established procedures will be asked to leave the work site.

7. EMERGENCY RESPONSE

This section discusses emergency response procedures and response equipment to be maintained on-site. A table presenting a list of contacts and telephone numbers for the applicable local and off-site emergency responders is provided inside the front cover of this HASP (after figures).

7.1 Injury and Emergency Response Procedures

In the event of an **injury** to an employee, the instructions for injury response and reporting, located in the front of this HASP, must be implemented immediately. In the event that an **emergency** develops, the following procedures are to be implemented:

- The SHSO, or designated alternate, should be immediately notified via the on-site communication system. The SHSO assumes control of the emergency response.

- If applicable, the SHSO must immediately notify off-site emergency responders (e.g., fire department, hospital, police department, etc.) and must inform the response team of the nature and location of the emergency on-site.
- If applicable, the SHSO may call for evacuation of the site. Site workers should move to their respective refuge stations using the evacuation routes provided on the Site Map.
- For small fires, flames should be extinguished using the appropriate type of fire extinguisher. Large fires should be handled by the local fire department.
- If a worker is injured, the procedures presented in "Instructions for Injury Response," located in the front of this HASP, must be implemented immediately.
- After an incident has stabilized, the procedures presented in "Instructions for Incident Reporting," located in the front of this HASP, must be followed.

7.2 Emergency Response Equipment

Emergency response equipment will be maintained in the work area as necessary for this project. Examples of emergency response equipment include first aid kits, fire extinguishers (Type ABC), and eyewash bottles.

8. KEY PERSONNEL AND HEALTH AND SAFETY RESPONSIBILITIES

Project personnel and their responsibilities in regard to health and safety concerns on this project are as follows:

Project Manager (PM): Tom Krasovec

- Approve this HASP and amendments, if any;
- Monitor the field logbooks for health and safety work practices employed;
- Coordinate with SHSO so that emergency response procedures are implemented;
- Check that corrective actions are implemented;
- Check and document that qualified personnel receive this plan and are aware of its provisions and potential hazards associated with site operations, and that they

are instructed in safe work practices and familiar with emergency response procedures; and

- Provide for appropriate monitoring, PPE, and decontamination materials.

Site Health and Safety Officer (SHSO): Jackie Rowley/Patrick Medland

- Prepare and implement project HASP and amendments, if any, and report to the PM for action if deviations from the anticipated conditions exist and authorize the cessation of work if necessary;
- Check that site personnel meet the training and medical requirements;
- Conduct pre-entry briefing and daily tailgate safety meetings;
- Check that monitoring equipment and PPE are operating correctly according to manufacturer's instructions and such equipment is utilized by on-site personnel. Calibrate or check calibration of monitoring equipment and record results;
- Check that decontamination procedures are being implemented;
- Implement site emergency response and follow-up procedures;
- Notify the HSC in the event an emergency occurs; and
- Perform and document weekly inspections.

Health and Safety Coordinator: Patrick Medland

- Review and audit HASP and amendments;
- Notify Director of H&S when an emergency occurs;
- Assist with the implementation of the corporate health and safety program; and
- Consult with staff on health and safety issues.

Site Workers:

- Provide verification of required health and safety training and medical surveillance prior to arriving at the site;
- Notify supervisors of workplace accomodation requirements as the result of physical limitations or medical conditions;

- Attend pre-entry briefings and daily tailgate safety meetings;
- Immediately report accidents and/or unsafe conditions to the SHSO;
- Be familiar with and abide by the HASP; and
- Be ultimately responsible for his or her own safety.

9. WORKER TRAINING AND MEDICAL SURVEILLANCE

Personnel involved in field activities subject to OSHA HAZWOPER 29 Code of Federal Regulations (CFR) 1910.120 will be required to participate in both a health and safety training program that complies with criteria primarily set forth by the OSHA HAZWOPER in 29 CFR 1910.120(e) and a medical surveillance program covered under 29 CFR 1910.120(f), or equivalent regulations based on the jurisdiction in which the project is performed.

9.1 Pre-Assignment and Annual Refresher Training

Prior to arrival on-site, the Geosyntec PM will be responsible for monitoring that their staff meet the requirements of pre-assignment training (40/24 hours per Procedure HS 301). In addition, personnel must be able to document dates of attendance at an annual 8-hour refresher and three days of fieldwork under a qualified supervisor. Failure to provide this documentation will prohibit entry to the active work area(s) (i.e., Exclusion Zone).

9.2 Site Supervisor Training

Consistent with OSHA 29 CFR 1910.120 (e)(4), prior to arrival on-site, individuals designated as site supervisors require an additional eight hours of specialized training.

9.3 Initial Site Safety Orientation and HASP Review

In addition to complying with 29 CFR 1910(e), site personnel will attend an initial safety orientation during which the HASP and applicable THAs will be reviewed prior to initiating field activities. This review will include the following:

- Understanding the lines of authority regarding health and safety and site personnel roles and responsibilities;

- Information of specific hazard agents related to the site and site operations will be discussed, such as health hazards of site chemicals and specific safety hazards of processes, tools, and equipment;
- Training in the proper use, maintenance, and decon protocol of PPE and Level(s) of Protection;
- Appropriate work practices and engineering controls to reduce/eliminate exposures to site hazards will be reviewed;
- Personnel will be informed of means for normal site and emergency communication(s);
- Air monitoring strategies will be discussed to include the frequency/types, action levels, sampling techniques, pre/post calibration techniques;
- Unique/site specific medical surveillance requirements that need to be considered based on site contaminants;
- Understanding site control measures, work zones, and proper decontamination procedures for personnel/tools/vehicles, etc. to reduce the potential for both on-/off-site contamination;
- Personnel will be trained to respond quickly and properly in the event of an emergency; and
- Personnel involved in specific hazardous activities, such as confined space entry, drum handling, sampling unknowns, etc. will receive specialized training in the appropriate techniques to employ prior to commencing these operations.

9.4 Baseline Medical Surveillance Exam

The baseline medical examination is used to identify physical capabilities and certain medical limitations that may have an impact on the candidate's ability to perform in the position and/or job activity for which he/she is being considered, as well as to establish certain baseline medical parameters. The initial test results can then be compared against future periodic or project-specific monitoring results.

9.5 Periodic/Annual/Biennial Medical Exam

The periodic medical examination is used to evaluate an employee's continued fitness for duty and to assess possible impact(s) occupational exposures may have had on their health status. The periodic examination includes an update to the medical and work history, results of previous occupational exposure assessments, and a detailed medical exam tailored to the job description.

The Medical Director from WorkCare determines the frequency of the periodic medical exams based on regulatory requirements, the position/work activities of the employee, and the level of exposure to physical, chemical, and biological agents.

9.6 Exposure/Activity/Project-Specific Medical Testing

Exposure-specific medical tests and/or evaluation of biological indices may be conducted to establish a baseline for certain project-specific parameters, to monitor the effectiveness of hazard controls, and/or to assess the impact of occupational exposures associated with a particular work activity or project. The Medical Director, in coordination with the H&S Department, will require or recommend an exposure-specific exam when deemed appropriate based on knowledge of project hazards, occurance of employee health symptoms, or an unexpected exposure event. Requests for exposure-specific examinations will be forwarded to the H&S Department, who will process the requests in collaboration with the Medical Director. The Medical Director will determine the type and frequency of the exposure-specific medical exams for employees designated to participate based on sound medical practice, latest toxicology information, and current regulatory requirements.

9.7 Exit Exam

An exit medical examination is offered when an employee leaves the medical surveillance program, either because of termination of employment with Geosyntec or because of reassignment to a position not designated or identified to participate in the medical surveillance program. This optional exit examination may be used to assess potential changes in medical status that have occurred during the course of employees' previous work activities, and to establish a medical baseline at the time of departure.

9.8 Exit/Termination

An exit medical examination is offered when an employee leaves the medical surveillance program, either because of termination of employment with Geosyntec or because of reassignment to a position not designated or identified to participate in the medical surveillance program. This optional exit examination assesses potential adverse impacts occupational exposures may have contributed to the employee's health status.

10. MAPS AND SITE CONTROL

10.1 Routes to Hospital and Urgent Care Facility

A hospital and an urgent care facility near the site have been identified. Maps to the hospital and urgent care are included after the Table of Contents of this HASP. Both figures also include the facility name and phone number.

10.2 Site Map

A site map is located inside the cover of this HASP. The site map is intended to show the location of the work zone(s), to provide on-site orientation, and to delineate evacuation

routes. Changes may be made to the site map by the SHSO based on changing site conditions. The site map should be accessible in the work area.

10.3 Buddy System

The buddy system is required when work is performed in hazardous areas. The buddy system includes maintaining regular contact with one or more onsite Geosyntec personnel, clients, and/or contractors to periodically check on the condition of site workers such that each employee in the work group is observed by (or in verbal contact with) at least one other employee in the work group. For field visits with only one employee onsite, the buddy system shall be implemented via periodic telephone contact with offsite Geosyntec personnel.The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

10.4 Controlled Work Zones

APPLIES TO TASK: ☒① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☐ NOT APPLICABLE

Three controlled work zones, including an Exclusion Zone, a Contaminant Reduction Zone (CRZ), and a Support Zone, are required for the task(s) indicated above. Geosyntec employees must not be allowed into the CRZ or Exclusion Zone or the Work Zone until they have donned the proper personal protective equipment (PPE) and they have read, understand, and meet the requirements outlined in this HASP. The Exclusion Zone is defined as the area on site where contamination is suspected and tasks are to be performed. The CRZ is defined as the area where equipment and workers are to be decontaminated as they leave the Exclusion Zone. The Support Zone is defined as the command area and may serve as a staging and storage area for supplies. The location and extent of the work zones may be modified as necessary as site investigation information becomes available And areas under investigation change.

Visitors to the site may need to be escorted for safety purposes. Visitors under Geosyntec's direction need to check in with the SHSO upon visiting the site.

For the tasks identified above, the boundaries of the Exclusion Zone, CRZ, and Support Zone, or the Work Zone, shall be marked using appropriate methods, including but not limited to warning tape, signs, traffic cones, fencing, or other appropriate means.

10.5 Site Access

Certain sites require controlled access to the work area. Examples of access controls include sign in/sign out logs, checking in with guards, and donning identification badges. Geosyntec personnel will adhere to the site-specific access requirements and monitor that subcontractors and other Geosytnec visitors abide by site-specific access control requirements.

Note: The Owner's Contractor, ACTenviro and/or their subcontractors (e.g., PSC Industrial Outsourcing, LP, or PSC) will be responsible for restricting site access and controlling work zone access to protect public health and safety as detailed in the Health and Safey Plan – Retail Ranch Remediation, prepared by PSC, dated November 2, 2017.

10.6 Inspections

☒ APPLICABLE ☐ NOT APPLICABLE

Based on the hazards identified for the project, periodic health and safety inspections may be performed. The H&S Inspection Checklist records should be kept on file at the project site. The frequency for periodic inspections is:

☐ Weekly

☐ Monthly

☒ Other: Daily inspections of trenches is required.

11. TAILGATE MEETINGS

Tailgate meetings must be held daily prior to starting work to discuss important health and safety issues concerning tasks to be performed during that shift. Non-Geosyntec site workers should also communicate health and safety concerns associated with the tasks they will be performing. Topics discussed in the tailgate meetings must be documented.

12. STOP WORK AUTHORITY

In accordance with the Company's Procedure HS 203 – Stop Work Authority, Geosyntec personnel and subcontractor personnel have the authority and responsibility to issue a Stop Work Order if unsafe actions and/or conditions are identified. The Stop Work Authority (SWA) process involves a stop, notify, correct, and resume approach for resolving observed unsafe work actions or conditions. The person issuing the work stoppage will first notify workers engaged in or affected by the unsafe activity or condition and require that associated work be stopped. After this Stop Work Order is issued, the Geosyntec PM and the supervisors for affected or concerned contractors will also be notified. The Geosyntec PM will document the issuance of the Stop Work Order on the form provided in Procedure HS 203. Work will not resume until the issues and concerns of the Stop Work Order have been adequately addressed.

13. AIR MONITORING

APPLIES TO TASK: ☒① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☐ NOT APPLICABLE

Air monitoring will be performed to evaluate airborne chemical and/or dust exposure levels within the breathing zone of site workers. Hazardous conditions may include concentrations that may cause acute or chronic illness, potential oxygen deficient environments, or potential explosive environments. Air monitoring may also be performed to evaluate the adequacy of engineering, administrative, and/or PPE controls. Air monitoring may be "real-time" (e.g., the instrument provides immediate results at the project), using multi-gas meters, photoionization detectors (PIDs), or colorimetric tubes. Personal monitoring may also be performed by collecting samples and forwarding to a laboratory for analysis and quantification.

The type(s) of air monitoring equipment required and associated action levels are outlined in Appendix D. Monitoring equipment must be calibrated based on the manufacturer's requirements. Calibration results and air monitoring measurements must be documented. Based on the results noted and site activities or scope of work changes, the frequency of air monitoring may be adjusted on site by the SHSO with the consent of the PM and communication with the HSC.

Note: The Owner's Contractor, ACTenviro, or their subcontractors (e.g., PSC) will be responsible for perimeter air monitoring to protect public health and safety as

detailed in the Health and Safey Plan – Retail Ranch Remediation, prepared by PSC, dated November 2, 2017.

14. PERSONAL PROTECTIVE EQUIPMENT

The levels of PPE required for each task are presented in

Appendix E. Required equipment and types of protective clothing materials, as well as an indication of the initial level of protection to be utilized, are listed. The level of

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE L per Task:	D C	D C	D C	D C	D C	D C	D C	D C

protection may be upgraded or downgraded by the SHSO according to controls requirements in

Appendix E or according to action levels provided in Appendix D.

If respirators are worn, workers must abide by the company's Respiratory Protection

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE L per Task:	D C	D C	D C	D C	D C	D C	D C	D C

Program in accordance with company's Respiratory Protection Program (HS 112).

15. DECONTAMINATION

The SHSO and PM will determine the type and level of decontamination procedures for both personnel and equipment based on evaluation of specific work activities in the controlled work zones. Medical treatment will take precedence over decontamination in the event of a life threatening and/or serious injury/illness. Personnel will perform decontamination in designated and identified areas upon leaving the Exclusion Zone where the potential exists for exposure to hazardous chemical, biological, or environmental conditions.

Decontamination of personnel in Level D (modified) will consist of proper containerization and disposal of coveralls, disposable boots, and gloves (if applicable).

Decontamination of personnel in Level C, if applicable, will consist, at a minimum, of:

- Removal and cleaning/disposal of boot covers, coveralls, and outer gloves;
- Removal, cleaning, and storage of respiratory protection;
- Washing of non-disposable PPE suspected of being contaminated using a soap solution followed by a water rinse; and
- Removal and disposal of inner gloves.

Hand tools and sampling equipment shall be decontaminated as needed by washing in decontamination basins with appropriate solutions, or, if possible, by dry decontamination. Wash solutions and PPE may require disposal at a licensed waste facility.

16. SPILL CONTAINMENT

The task(s) for this project may involve the handling of drums and/or containers that contain stored chemicals, hazardous materials, and/or wastes. The drums and/or containers may have been spilled/dislodged during site activities due to compromised construction of the drum/container, transportation accidents, improper packaging practices, and improper handling of hazardous materials during on/off loading. Containers shall be inspected and their integrity assured prior to being moved and/or handled. If the integrity of the container is in question, the container shall be over packed or its contents transferred. Operations shall be organized and coordinated to minimize movement of such containers. Where spills, leaks, or ruptures may potentially occur, a supply of sorbents shall be located in the immediate area. Additional preventative measures include:

- UN-approved 55-gallon drums, bins, and/or Baker tanks will be inspected for visible defects upon delivery to the site;

- UN-approved 55-galon drums will also be inspected to ensure each drum includes a resealable lid with a small resealable sampling port near the top, or on the side of the drum and that the enclosure is not deformed and/or distorted;
- Drums will not be completely filled to allow for possible expansion of liquid and will may be set on wooden pallets to facilitate transport by forklift;
- The storage area will be inspected to check for leaks daily while the containers are being filled and immediately after a relocation to a temporary on-site storage area; and
- Flat areas will be selected for temporary storage away from high-traffic work areas/zones and storm/sewer drains.

In the event of an unplanned release or spill of unknown or hazardous substances, the site supervisor will designate personnel who will support the spill containment, control, and/or clean-up procedures. The team will request additional off-site emergency response assistance if necessary based on the type of spill, volume, potential toxicity, etc.

The spill area will be isolated and restricted to only authorized personnel designated to assist with the containment, control, or clean-up activity. Authorized personnel will be trained to contain and clean spills from typical materials and quantities used at the project location. Physical barriers will be set up to warn unauthorized personnel to stay clear and evacuate the affected area. The spill, leak, or incident will be assessed by the team and characterized to determine the appropriate course(s) of action(s) to consider:

- Small spills (i.e., maximum volume of 55 gallons of a liquid or 100 pounds of a solid) may be cleaned up using absorbent materials by designated personnel;
- Large spills (i.e., liquid volumes greater than 55 gallons or solid weights greater than 100 pounds) and/or spills of highly toxic materials may require assistance by off-site hazardous materials (HAZMAT) teams;
- Attempts shall be made to identify and stop the source(s) of spillage immediately while donning proper PPE (based on action levels and the air monitoring program) and performing air monitoring;
- The site supervisor will direct spill-response operations and stay at the spill area until it has been cleaned, inspected, and cleared for re-entry; and

- The site supervisor will prepare a spill incident and clean-up report and will communicate findings to the Project and Branch Manager and H&S Department.

17. CONFINED SPACE ENTRY

☒ APPLICABLE ☐ NOT APPLICABLE

The task(s) for this project involve confined-space entry. Workers must abide by the company's Confined Space Entry Program (Procedure HS 118).

18. GLOBALLY-HARMONIZED SYSTEM FOR HAZARD COMMUNICATION

☒ APPLICABLE ☐ NOT APPLICABLE

The following procedures must be followed for chemicals brought onto the site by Geosyntec personnel or by subcontractors (i.e., decontamination solution, sampling preservatives, KB-1® solution, sodium permanganate, etc.) while performing the tasks of this project:

- Labels on primary chemical containers must not be defaced;
- Chemicals must be stored in appropriate storage containers;
- Secondary containers and storage cabinets must be correctly and clearly labeled;
- Chemicals incompatible with each other must not be stored together;
- Workers must receive training on the chemical hazards; and
- Safety Data Sheets (SDSs) must be added to Appendix G.
- Health and Safety Procedures, Appendix F.

When chemicals are used on-site, workers must abide by Geosyntec's GHS Hazard Communication Program (Procedure HS 115).

19. HASP AMENDMENTS

Over the course of this project, it is possible that the project-specific hazards and working conditions will change. This HASP may be reviewed and amended as necessary to effectively describe the changing working conditions and measures to mitigate the potential health and safety issues that may arise during the project. Amendments to the HASP should be briefly described in the following spaces provided. The full text of the amendments should be provided in Appendix A and/or additional THAs should be added to Appendix B.

Appendix A: HASP Amendments

Discuss details of amendments to this HASP here. Include amendment number, date, and details of amendments.

AMENDMENT 1:

Date: _____ Project Manager: _____ HSC: _____

Brief Description of Amendment:

AMENDMENT 2:

Date: _____ Project Manager: _____ HSC: _____

Brief Description of Amendment:

AMENDMENT 3:

Date: _____ Project Manager: _____ HSC: _____

Brief Description of Amendment:

Appendix B: Task Hazard Analyses

TASKS	
① Oversight of Excavation and Drum Removal and Soil Sampling	⑤
②	⑥
③	⑦
④	⑧

THAs for these tasks are presented in the following pages.

Geosyntec consultants

Geosyntec HS Procedures referenced herein are available on Geosyntec's H&S SharePoint site and should be consulted, as appropriate, per project-specific needs. This TEHA prepared per HS-106-Accident Prevention Program, HS-204-Task Hazard Analysis, and meets the requirements for a "Site-Specific Health and Safety Plan" per Geosyntec HS Procedures and regulations referenced herein (see Section B.14.).

TASK & ENVIRONMENTAL HAZARD ANALYSIS (Ver. 2, June 2015)

PART A – SITE SAFETY PLAN

A.1. PROJECT/TASK INFORMATION

TASK:	Oversight of Excavation and Drum Removal and Soil Sampling		
Project Name:	Stratus Redtail Ranch	**Project Number/Org:**	DE0302 / 3310
Project Address:	Northwest corner of Weld County Rd. 4 and Weld County Rd. 5, Erie CO		
Description of Task & Worksite:	Geosyntec personnel will document drum removal and support segregation of hazardous and non-hazardous soild waste. Additionally, Geosyntec personnel will use field screening techniques to identify excavated material that may have been impacted with site COCs. This role will include working near an active excavation pit with operating heavy equipment. Field screening will most likely involve use of a flame ionization detector (FID) and possibly field screening kitsto measure drum headspace concentrations and identifiy impacted soils.. Documentation will involve note-taking, photography, and labeling. Worksite is undeveloped land in Erie CO.		

- Geosyntec Personnel	- Name	- Desktop Office Phone	- Mobile Phone
- Site Lead/HS Officer	- Jackie Rowley/Patrick Medland	- 720-509-8924/720-509-8907	- 331-308-3653/517-242-0515
- Project Manager	- Tom Krasovec	- 720-509-8911	- 517-719-4984
- Project Director	- Dave Folkes	- 720-509-8913	- 720-560-1707
- HS Coordinator	- Patrick Medland	- 720-509-8907	- 517-242-0515
- HS&E Mngr.	- Dale Prokopchak	- 804-332-6376	- 804-349-8067
- Corp. HS Director	- Dale Prokopchak	- 804-332-6376	- 804-349-8067
-	-	-	-
- **Client Contact(s):**	- Richard Dean, Manager	-	-
- **Subcontractor(s):**	- ☒ Not Applicable ☐ Applicable, provide contact information below:		
	-	-	-

A.2. EMERGENCY RESPONSE

Based on analysis of worksite factors, client/regulatory requirements, availability of emergency services.

Consider all Relevant Risk Factors & Response Procedures *(fire/explosion, medical, chemicals/spills, security, site factors, weather, communications)*.
EXPLANATORY NOTES, CLARIFICATIONS:

Available Means of Jobsite Emergency Communication/Alerting	☒ Verbal ☒ Mobile Phone ☐ Land Line ☐ 2-Way Radio ☐ On-site alarm/signal system ☐ Other:
To Summon Emergency Services Police, Fire, Ambulance	☒ **DIAL 911**, for external responders ☐ **Other**:
Other Emergency Contacts, as needed *(such as security, spill responder, utility):*	National Response Center (800) 424-8802 CDPHE Emergency Response Center (877) 518-5608
Nearest Emergency Medical Services	Hospital Name: Good Samaritan Medical Center Address: 200 Exempla Circle, Lafayette, CO 80026 Phone #: 303-689-4000 ☒ See Attached Directions
For **Non-Emergency Urgent Care**	☒ Contact WorkCare, 24/7 at: 888-449-7787

Job-site **Evacuation** Procedure, Rally Point, Place of refuge:	Personnel should evactuate north from the exclusion zone through the entry/exit location located at the CRZ. Assuming the location is safe, personnel shall take refuge in the Support Zone. Otherwise, personnel shall evacuate to the west or east, whichever is upwind from the potential source of danger.
Special Emergency Equipment/Procedures	

IMPORTANT: After initial emergency response actions and incident stabilization, contact appropriate project personnel listed in Part A.1.

A.3. SUMMARY OF WORK STEPS, HAZARDS, CONTROLS

Based on **PART B, "HAZARD ANALYSIS,"** and worksite/client/project factors.

Summary/outline of work steps/hazards/controls, with references to applicable Sections in Parts B and C, as applicable:

WORK STEPS	HAZARDS	CONTROLS
Mobilize to and from Site	Distracted Driving	*Focus on driving and do not multi-task. Use defensive driving techniques. Plan route before driving. Be aware of surroundings when/if off-road*
Oversee excavation and drum removal and headspace monitoring	Toxic vapors, cave-ins, working near heavy machinery, accidental release	*Stay upwind of excavation when in support zone, stay clear of excavation areas, practice good housekeeping, make sure drums are placed into secondary containment, be aware of surroundings*
Field Screening and collection of Soils	Toxic vapors, cave-ins, working near heavy machinery	*Use a respirator when in exclusion zone, practice good hygiene and housekeeping, be aware of surroundings – especially if excavation entry is required, wear appropriate PPE.*

A.4. HS&E EQUIPMENT LIST

List worksite equipment for worker protection; provide details in Explanatory Notes, Clarifications.

EXPLANATORY NOTES, CLARIFICATIONS:

☒	**ROUTINE PPE**	☒ Standard work clothes appropriate for task ☒ Hard-toed boots/shoes ☒ Hardhat ☒ Safety glasses		☒ Work gloves appropriate for task ☒ Noise/hearing protection ☒ High-visibility/reflective vest
		☒ Basic PPE for protection from low-hazard chemical contact & dust (nitrile gloves, Tyvek suit, dust mask, boot covers).		
☒	**ROUTINE HS&E EQUIPMENT/GEAR**	☒ First Aid Kit ☐ Fire extinguisher ☐ Emergency eyewash bottle(s) ☐ Insect control (repellant, wasp spray, other) ☐ Caution tape		☐ Sun protection (sunscreen, shade canopy, other) ☒ Project-supplied drinking water and/or hygiene facilities ☐ Absorbent matting/roll ☐ Vehicle emergency kit (flares, lights, reflective device) ☐ Traffic control warning devices (cones, or similar)
		☐ Other:		
☒	**NON-ROUTINE PERSONAL PROTECTIVE EQUIPMENT (PPE)** (Indicate specific types of PPE in Explanatory Notes, Clarifications)	☒ Goggles and/or face shield ☒ Chemical protective gloves ☒ Coveralls (Tyvek, or other) ☒ Outer boots, boot covers	☐ Disposable n-95 dust mask ☒ Half-face respirator (APR), cartridges ☐ Full-face respirator (APR), cartridges ☐ Personal flotation device	☐ Fire retardant clothing ☐ Arc Flash Protection ☐ Electrical-Hazard-rated boots, gloves ☐ Personal fall apparatus
		☐ Other:		
☐	**SPECIAL HAZARD CONTROLS**	☐ Portable GFCI	☐ Lockout/tagout equipment	☐ Ventilation equipment (fan, blower)
		☐ Eyewash - 15 min. flow	☐ Emergency deluge shower	☐ Air horn, alarm
		☐ Other:		
☒	**DECON, PPE DISPOSAL**	☒ Receptacle for disposable PPE	☐ Hand washing provisions	☒ Decon solution, related supplies
		☐ Other:		
☒	**AIR MONITORING EQUIPMENT, OTHER EQUIPMENT FOR WORKER EXPOSURE TESTING**	FID and 5 Gas Meter (LEL, VOC, O_2, H_2S, and CO)		

PART B – HAZARD ANALYSIS and CONTROLS *Complete Section B.1., then subsequent sections as applicable to the task(s).*

B.1. ROUTINE HAZARD PREPAREDNESS **This section required for all tasks.**

Explanatory Notes, Clarifications: Operations are not planned outside of daylight hours. However, if approved by ACTenviro or its subcontractor, night work may be required.

General Safety, Wellness, Preparedness – **Delineate site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☒ **General premises** hazards - housekeeping, rough terrain, trip hazards, steep slope, remote location.
☒ **Weather/climate-related hazards** – heat stress/cold stress measures, sun screen, severe weather shelter/refuge, "30/30 rule" for lightning
☒ **Plant/Insect/Animal Hazards** - Precautions: poison ivy wash; insect repellant; check for ticks; hornet nest spray; animal precautions.
☒ **Worksite traffic hazards** – Implement measures to protect personnel (high visibility/reflective clothing, on-person lighting, traffic control measures).
☒ **Illumination hazards/night work** - Illuminate work areas and/or access routes, use reflective/hi-visibility clothing or on-person lighting, as appropriate.
☐ **Lifting, manual material handling** – use proper lifting procedures, seek help for >50 lbs.

Geosyntec Procedures: *HS-124-Heat Stress, HS-125-Cold Stress, HS-127-Ticks, HS-208-Housekeeping, HS-210-Walking and Working Surfaces, HS-401-Back Injury Prevention, HS 517 Traffic Safety*

Routine Personal Protection – **Delineate site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☒ **Head protection from overhead hazards** - Wear hardhat or "bump cap" as appropriate for hazard.
☒ **Hand protection** - Wear protective work gloves appropriate for the hazard and work tasks.
☒ **Eye protection** - Wear safety glasses (with side shield or wrap around, either clear or shaded for sun protection), or other appropriate eye protection.
☒ **Foot protection, rough terrain** - Wear work boots/shoes with hard toes, ankle support, puncture resistance, traction, as appropriate for conditions.
☒ **Hearing protection** – use earplugs, earmuffs (or both) as appropriate for conditions; at a minimum where noise levels exceed 85dBA.
☒ **Dust, unsanitary conditions** – For general protection against minimal non-specific hazards, use protective clothing and/or disposable dust mask, as needed.

Geosyntec Procedures: *HS-109-Hearing Conservation, HS 112-Respiratory Protection, HS-113-Personal Protective Equipment, HS-207-Working Alone, HS-105-Driver and Vehicle Safety*

Tools, Equipment, Machinery – **Delineate site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☒ **Manual hand tools -** proper tool for the job, maintain in good condition, use vise/clamp to hold work piece, proper follow through, stay clear of "line of fire."
☐ **Knives, cutting tools -** Utility/folding/collapsible knives and fixed open-bladed knives/cutting tools are *not* permitted, unless specifically authorized. Cutting tools with automatically-retracting blades, or with enclosed/guarded blades are permitted. See HS-502-*Manual Hand Tools* for additional Information.
☒ ***Working near*** **powered tools/equipment/machinery** – safe distance, heed warning signs, stay out of "line of fire," use PPE (for eye/hearing/dust protection).
☐ ***Operation/use of*** **powered tools/equipment/machinery – See Section B.5.**

HS-502-Manual Hand Tools

Security– **Delineate site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☐ **High crime, urban** – Use appropriate measures for personal security (such as buddy system, security service, work scheduling, other measures)
☒ **Working alone** - Establish "check in" procedure with supervisor/project manager.

Geosyntec Procedures: *HS-207-Working Alone*

Routine Driving Hazards – **Delineate site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☒ **Routine work travel** - Use routine safe/defensive driving practices (seat belts, safe speeds, eyes ahead, no tailgating, limit distractions, safe cell phone use, no texting, clear windows, account for weather/road conditions, adequate sleep, other measures as appropriate).
☒ **Unfamiliar location** - Plan travel route before driving (assemble maps, enter destination in GPS).
☐ **Long Distance or During Sleep Hours** – Minimize fatigue: rest breaks, light snacks (avoid heavy meals), stay hydrated, fresh air, no loud music, clean windshield.
☐ **Unfamiliar vehicle** – Become familiar with vehicle operational controls and handling characteristics before operating vehicle.

Geosyntec Procedures: *HS-105-Driver and Vehicle Safety*

B.2. SPECIAL DRIVING/TRAFFIC/TRANSPORTATION HAZARDS ☒Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☐	**SPECIAL DRIVING HAZARDS** Off-Road Driving or use of non-typical vehicle, heavy vehicle, van, golf/utility cart, ATV Hazards: Worker injury due to vehicle collision, rollover	☐ For off road driving, do not exceed capability of vehicle, beware of wet conditions, speed low, avoid unsafe orientation on slopes. Follow ATV specific procedures for training, safety equipment, operation, manufacturer's instructions. ☐ Special Skills Required for Vehicle type - For vehicles requiring special skills (such as windowless van, heavy work vehicle, utility vehicle, similar) ensure operator is provided training and/or has appropriate operator skills through experience. ***Geosyntec Procedure(s):*** *HS-510-All Terrain Vehicles*
☐	**TRANSPORTING MATERIALS, TOWING/HAULING LOADS** Hazards: Vehicle accident, occupant injury from shifting load, unsafe equipment.	☐ Ensure load is firmly secured (rope, straps, load configuration) to prevent shifting during travel. ☒ Slings, chains, strap, rope and related equipment used for towing, hauling, load-securing shall be appropriate for use, and used in a manner as to prevent an unsafe condition. ☐ For trailer use, verify signal/braking lights operational, rear-view mirrors effective, hitch/safety chains secure.

☒	**WORKSITE TRAFFIC HAZARDS** Where the project worksite is located in/near vehicle thoroughfare. Hazards: Worker injury from being struck by vehicle traveling in thoroughfare.	☒ Wear reflective vests where exposed to traffic hazards. ☐ Where possible, park vehicles as protective shield from oncoming traffic. ☐ Configure work area and support vehicles to minimize worker exposure to traffic hazards. ☐ Use DOT signal devices to re-route vehicles around work area, site entrances/exits. ☐ Use DOT-trained flaggers or police detail where appropriate or required. ***Geosyntec Procedure(s):*** *HS-517-Traffic Safety*
☐	**RAILROAD HAZARD** Hazard: Worker injury from being struck by train in R.R. right-of-way	☐ Coordinate with rail company and implement required safety and security measures. ☐ Site workers to receive safety training for railroad work. **Geosyntec Procedure(s):** HS-305-Rail Operations
☐	**WATER TRANSPORTATION**	☐ Follow HS 312 "Water Transportation Safety," and Section B.3., "Water/Boating Hazards." **Geosyntec Procedure(s):** HS-312-Water Transportation Safety
☐	**AIRPORT, AIRCRAFT** Worker injury when working on/near airport runway, or use of helicopter, light aircraft	☐ Coordinate safety requirements with Airport personnel and implement required safety measures. ☐ Site workers to receive safety training for railroad/airport work. ☐ Follow provisions of applicable Geosyntec HS Procedures, below: ***Geosyntec Procedure(s):*** *HS-310-Helicopter Safety, HS 311-General Aviation (Small Aircraft) Safety*
☒	**TRAFFIC/VEHICLE HAZARDS REALATED TO HEAVY EQUIPMENT, CONSTRUCTION SITE ACTIVITIES**	☒ See Section B.7., "Construction, Heavy Equipment, Lift Equipment"

B.3. WATER/BOATING HAZARDS ☐ Applicable ☒ Not Applicable or Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☐	**OPERATOR OF WATER CRAFT OR PASSENGER/WORKER ON WATER CRAFT OR PLATFORM** Hazards: Drowning, hypothermia, collision, motor/fuel hazards, navigation	☐ Wear regulatory-approved personal flotation device (PFD) or buoyant work vest. ☐ Bring emergency rescue equipment (ring buoy, reaching device, flares). Use "reach, throw, row, go" strategy. ☐ Use fuel safety practices, fire extinguisher present in boat. ☐ Have lifesaving skiff/boat available. ☐ Monitor weather, develop float plan, ensure navigation/communication equipment operable. ☐ For tidal, flash flood, dam release hazards, plan/locate work accordingly, other precautions as appropriate. ☐ Where ice/slip hazards are present adjacent to water body, and for working directly on ice over water, wear ice creepers, sand work area, or take other appropriate measures to address slip hazard. ☐ For high-hazard work over very cold water, have immersion survival suit available, as appropriate. ☐ For electrical hazards associated with water/wet locations, see Section B.8., "Electrical Hazards." ***Geosyntec Procedure(s):*** *HS-306-Working on/near Water and Ice, HS-312-Water Transportation Safety*
☐	**WORK NEAR WATER HAZARDS OR ENTERING WATER** Hazards: drowning, hypothermia from water immersion, related injuries. ☐ Wading, wetland, mud/silt ☐ Dam release, flash flood, tide ☐ Diving ☐ Ice on/near water body	

B.4. FALL HAZARDS ☐ Applicable ☒ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

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☐	**WORKING AT HEIGHTS (GENERAL)** Hazards: Falls, overhead hazards, impalement hazard (such as from falling onto unprotected rebar and similar)	*General fall protection requirement thresholds: required @ ≥4' (industry), ≥6' (construction), ≥10' (scaffolds)* ☒ Ensure guardrails present ☐ Use personal fall apparatus (PFA) ☐ Use tether or positioning device ☐ Restrict access to hazard (barriers, tape, sign) ☐ Ensure covers in place over holes ☐ Use designated "watch person" ☐ Use fall protection net ☐ Restrict access beneath work to protect other site personnel from overhead hazards ☐ Ensure safe access to elevated work location (ladder, stair,) ☐ Install caps on protruding ebar ***Geosyntec Procedure(s):*** *HS-120-Fall Protection, HS-210-Walking and Working Surfaces*

☐	**LADDERS / STAIRS** ☐ Extension/straight ladders ☐ Step ladders ☐ Fixed ladders ☐ Stairs Hazards: Falls, overhead hazards	☐ Follow safe work practices: • Use ladders according to safe practices and manufacturer's instructions. • Maintain 3 points of contact at all times on ladder; keep center of gravity within side rails. • Do not use metal (conductive) ladder near electrical hazard. • Extension/straight ladders shall be properly footed, secured, angled, extend above upper work surface. • Stepladders are set on level ground or properly shimmed, spreaders locked; do not climb/stand on top step, top cap, or rear non-climbing side; use step ladder of sufficient length for work. • Equip stairs with stair-rails where more than 4 steps, and for stairway height 4' or more. ***Geosyntec Procedure(s):*** *HS-501-Ladders*
☐	**SCAFFOLD** ☐ Supported scaffold ☐ Suspended scaffold ☐ Free-standing/mobile scaffold Hazards: Falls, overhead hazards, equipment collapse.	☐ Follow safe work practices: • Identify/coordinate operations with subcontractor's competent person. • Supported scaffold level, stable, proper attachments, tiebacks, planking, • Suspended scaffolds anchored properly. • Guardrails or personal fall apparatus required above 10 feet. • Proper means of accessing scaffold (proper ladders, stair tower). • Total height of free-standing scaffold not to exceed four times the minimum base dimension. • Do not exceed load limits; store/stage materials in quantities sufficient for immediate use. ***Geosyntec Procedure(s):*** *HS-507-Scaffolds*
☐	**AERIAL LIFT** Hazards: Falls, overhead hazards, struck-by, run-over, caught between (pinch points), tip over, fluid leaks.	☐ Follow safe work practices: • Operators to be sufficiently trained, experienced and qualified. • Equipment is inspected after mobilization and is in good condition. • Harness & lanyard worn whenever operating the lift (possible exception for scissor lifts). • Overhead and surface obstructions to be reviewed with operators prior to use. ***Geosyntec Procedure(s):*** *HS-509-Aerial Lifts*
☐	**IMPORTANT!** This work may/will include close proximity to overhead electric utility lines.	☐ Follow safe work practices per Section B.9., "Utility Related Hazards"

B.5. POWERED TOOLS, EQUIPMENT, MACHINERY ☐ Not Applicable, Not Anticipated ☒Applicable

EXPLANATORY NOTES, CLARIFICATIONS:

☒	**POWERED HAND TOOLS** ☒ Battery-operated ☐ Electric-powered, 120v/240v ☐ Fuel-powered ☐ Pneumatic ☐ Powder-actuated Hazards: Eye/hand/body injury, fuel-related hazards, Inhalation hazards, noise, sparks, heat, fire hazard, electrical hazards	☒ For all power tools: • Inspect tools to ensure safe operating condition before each use. • Use tool in accordance with manufacturer's specifications. • Ensure guards are in place and no hazardous equipment modifications. • Use PPE or other safety practices, as appropriate, for eye/hearing/hand/head/body protection. • Provide training or verify operator competency for use of power tool. • Stay clear of hazard zone, "line of fire," when working near where power tools are used. • For spark/heat generating tool, control fire hazards, segregate combustible/flammable materials. • Use vise/clamp/work bench or other appropriate means to hold/secure the work piece. ☐ Use respirators, ventilation, wet methods, other appropriate means to control inhalation hazard. ☐ See fuel-safety practices in Section B.13., "Commercial Chemical Products." ☐ For electrical hazards, see Section B.8., "Electrical Hazards". ***Geosyntec Procedure(s):*** *HS-109-Hearing Conservation, HS-113-Personal Protective Equipment, HS-121-Electrical Safety, HS-503-Powered Hand Tools, Others as applicable*

☐	**OPERATION OF EQUIPMENT/MACHINERY** ☐ Point-of-operation hazards ☐ Pinch points, moving parts ☐ 'Struck-by,' 'caught between' ☐ Hot surfaces, heat ☐ Extension cords, flexible wire ☐ Fuel related (gas or liquid) ☐ Hydraulic pressure ☐ Pneumatic pressure ☐ Kinetic, stored energy ☐ Noise ☐ Emissions, discharge gases ☐ Working at heights, falls ☐ Lifting, repetitive motion ☐ Illumination ☐ Electrical	☐ <u>General safety requirements for equipment, machinery:</u> • Arrange worksite for safe access to equipment/machinery. • Use equipment/machinery in accordance with manufacturer's use and safety instructions. • Ensure point-of-operation, mechanical power transmission, other moving parts are guarded with protective devices; do not override interlocks, guards, protective devices. • Secure long hair/loose clothing/hanging jewelry near moving/rotating parts. • Heed warning signs/labels, keep safe distance; avoid locations of "struck by" and "caught between" hazards. • Implement lockout/tagout for repairs/adjustments/tooling changes. ☐ Use safe lifting practices for movement of heavy portable equipment ☐ Implement safe work practices for compressed air, pressurized systems (pneumatic/hydraulic), stored energy. ☐ For climbing/fall hazards associated with large equipment, see Section B.4., "Fall Hazards." ☐ For electrical hazards, see Section B.8., "Electrical Hazards." ☐ Operate fuel-powered equipment in well ventilated location. ☐ Use safe practices for fuels, see Section B.13., "Commercial Chemical Products." ***Geosyntec Procedure(s):*** *HS-109-Hearing Conservation, HS-113-Personal Protective Equipment, HS-119-Lockout/Tagout, HS-121-Electrical Safety, HS-503-Powered Hand Tools, Others as applicable*
☐	**LOCKOUT/TAGOUT OF HAZARDOUS ENERGY**	☐ Implement control-of-hazardous-energy practices (lockout/tagout), provide lockout/tagout locks and devices, training workers, designate "authorized" personnel, notify "affected" personnel. ***Geosyntec Procedure(s):*** *HS-119-Lockout Tagout*
☐	**WELDING, CUTTING, HOT WORK (GAS OR ARC)** UV/IR light-eye/skin burns, hot-work hazards, toxic welding fumes, compressed gases, electrical shock	☐ <u>General safe work practices:</u> • Hot work permit system to be implemented. • Operator properly protected (eye protection, clothing, apron, etc.). • Fire hazard controls (watcher, fire extinguisher, water, isolate combustibles). • Protect nearby personnel from hazardous UV, IR light (shielding, curtain). ☐ For gas welding/cutting, use gas cylinder safe practices (secured, upright, caps on when not in use, prevent Damage; never secure gas cylinders to metal bench used for arc welding). ☐ For arc welding, follow electrical safe work practices. See Section B.8., "Electrical Hazards." ☐ See Section B.13., "Commercial Chemical Products," for hazards of welding rods (toxic metals), welding gases. ***Geosyntec Procedure(s):*** *HS-511-Welding, Cutting and Other Hot Work*
☐	**COMPRESSED AIR, COMPRESSOR** (for compressed gases, see Section B.13., "Compressed Gases")	☐ Never direct nozzle toward body; do not use compressed air for cleaning clothes. ☐ If compressed air is used for cleaning, restrict pressure to 30 psi or below, equip nozzle with chip guard. ☐ Use eye protection. ☐ Ensure air tank, hoses, fittings are in good repair using factory fittings.
☐	**PORTABLE GENERATOR** Hazards: Electrical shock, carbon monoxide in exhaust, fuel-related fire, injury from mechanical hazards, lifting	☐ <u>Follow general safety practices for Operation of Equipment/Machinery (above), and as follows:</u> • Use in accordance with manufacturer's instructions. • Keep generator and work area dry. • Never use indoors, or near building air intake vents due to carbon monoxide hazard. • Provide for ventilation and/or air monitoring where hazardous accumulation of exhaust emissions is possible. • Use hearing protection in close proximity to operating generator, as needed. • Use power cords/extension cords specified by instructions. • Use ground-fault circuit interrupters (GFCIs) in accordance with manufacturer's instructions. • See Section B.8., "Electrical Hazards." • Shut down equipment before refueling. See safe practices for flammable/combustible liquids in Section B.13., "Commercial Chemical Products." ***Geosyntec Procedures:*** *HS-109-Hearing Conservation, HS-111-Air Monitoring, HS-115-Hazard Communication (for fuel), HS-121-Electrical Safety, Others as applicable*

☐	**PORTABLE HEATERS** **(electric or fuel powered)** Hazards: Electric-powered: Electrical shock, fires from hot surfaces. Fuel powered: Carbon monoxide in exhaust, fires from hot surfaces, fuel-related fires	☐ Follow general safety practices for Operation of Equipment/Machinery (above), and as follows: • Keep heater dry, and locate heater on level surface away from high traffic areas. • Never use fuel-powered heaters indoors, or near air intake vents, due to carbon monoxide hazard. • Provide for ventilation and/or air monitoring where hazardous accumulation of exhaust emissions is possible. • Keep combustible materials at least 3 feet from hot surfaces. • Do not use an extension cord or power strip to power an electric heater. • For electric heaters, See Section B.8., "Electrical Hazards." • Shut down fuel-powered equipment before refueling. See safe practices for flammable/combustible liquids and/or compressed gases in Section B.13., "Commercial Chemical Products." ***Geosyntec Procedures:*** *HS-111-Air Monitoring, HS-115-Hazard Communication (for fuel, HS-121-Electrical Safety, Others as applicable*

B.6. DRILLING ☐ Applicable ☒ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☐	**DRILLING** Hazards: Struck-by, run-over, caught between (pinch points), manual lifting, roll over, fluid leaks, fuel hazards, suspended equipment	☐ Follow safe work practices, as applicable: • Non-essential personnel to stay clear of drilling work zone when drill rig in operation. • Equipment inspected daily upon mobilization; maintained in good repair, backup alarms. • Leaks or defective safety equipment should be repaired before use. • Establish eye contact with operator and use hand signals prior to approaching near equipment. • PPE used near operating rig (eye/head/hearing/hand/foot protection, high visibility vests or equivalent). • Contractor inspects drill rig daily before use, verify daily that emergency stop is functional. • Drill rig to be equipped with operational emergency stop, equipment in good repair, machine guards in place, whip checks on high pressure lines. • Park personal/support vehicles in a location as to not obstruct travel lanes or other site operations. • Operators/helpers maintain safe distance from moving parts; secure loose hair, loose clothing, equipment. • Drill rigs will only be moved with masts lowered. • Max. safe slope for rig will be followed, drill rig leveled, appropriate blocking/cribbing as needed. • Use safety practices for refueling, fuel handling/storage/transport. • Spill equipment is available for fuel and hydraulic fluid leaks. • Verify mechanical lift/rigging equipment (cables, sheaves, boom, attachments) is in proper working order. • Ventilate and conduct air monitoring, as appropriate, when drilling indoors. ***Geosyntec Procedure(s):*** *HS-403-Drilling, Others as applicable*
☐	**IMPORTANT!** This work may/will include close proximity to overhead electric utility lines.	☐ Follow safe work practices per Section B.9., "Utility Related Hazards"

B.7. CONSTRUCTION, HEAVY EQUIPMENT, LIFT EQUIPMENT ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☒	**HEAVY EQUIPMENT** Hazards: Struck-by, run-over, caught between (pinch points), roll over, fluid leaks, overhead hazards	☒ Follow general safe work practices for heavy equipment: • Trained/qualified persons operate all heavy equipment. • Do not get into a potential crush situation below or between equipment, or in an excavation. • No passengers on moving/operating equipment except where passenger seat/restraint is present. • Equipment inspected daily upon mobilization; maintained in good repair, backup alarms. • Leaks or defective safety equipment should be repaired before use. • Operators required to use seatbelts. • Maintain eye contact with operator and use hand signals prior to approaching near equipment. • High visibility vests for all personnel in construction vehicle work area, on-site roadways and travel lanes. • Maximum safe slope for each vehicle will be followed. • Personnel to stay clear of, or restrict access to, swing radius and travel path of equipment. • Spill equipment available for fuel and hydraulic fluid leaks.

		• Equipment locked, secured, brakes set, buckets/forks lowered, when not in use. • Park personal/support vehicles in a location as to not obstruct travel lanes or other site operations. • Mark temporary roadways clearly, provide berms/stop logs where needed. ***Geosyntec Procedure(s):*** *HS-504-Heavy Equipment, HS-132-Competent Persons*
☐	**CRANES** Hazards: - electrocution by overhead utility - injury in swing radius - injury from falling load - crane tipping over due to overbalancing, high winds, unstable ground, unsafe slope, bad placement of outriggers - injury from mechanical hazards	☐ <u>In addition to general safety practices for heavy equipment (above), as applicable</u>: • Only qualified persons operate cranes (certificate required). • Critical Lift Plan & Checklist prepared/executed (HS 506) prior to mobilization. • Equipment to be inspected prior to mobilization and daily by crane operator. • Crane operator will remain at the controls at all times during operation. • Crane operation must be performed under the direction of an appointed signal person at all times. • Communication between crane operator and signal person will be maintained through standard hand signals or voice communication equipment. • Keep area beneath suspended loads clear of personnel. • Rigging procedures – see Mechanical Lifting, Rigging, below. ***Geosyntec Procedure(s):*** *HS-506-Cranes, HS-132-Competent Persons*
☒	**MECHANICAL LIFTING, RIGGING** Applies to lifting by crane, truck-mounted boom rig (e.g. drill rig), mechanical/electrical hoist, similar equipment. Hazards: falling loads, personnel under suspended loads.	☒ <u>In addition to general safety practices for heavy equipment and cranes (above), as applicable:</u> • Coordinate lifting operations with competent person. • Do not exceed loading limits of lifting equipment; perform work in accordance with equipment load chart. • Slings, chains, rope, wire rope and related equipment used for lifting shall be maintained in good condition, and used in a manner as to protect from damage. • Rigging, wire rope and hoisting equipment will be inspected and maintained on a weekly basis. • Hooks will be equipped with safety latches. • Ensure anchor points for winch or other lift device (such as davit arm) are engineered for intended use. ***Geosyntec Procedure(s):*** *HS-506-Cranes*
☐	**FORKLIFT** Hazards: Struck-by, run-over, overhead hazards, caught between (pinch points), roll over, fluid leaks.	☐ <u>In addition to general safety practices for heavy equipment (above), as applicable:</u> • Qualified operator, per established forklift training (certificate is required). • Equipment inspected daily and documented on Forklift Preoperational Inspection Checklist. • Do not exceed lifting load limits. • Forklift shall not be moved/driven with empty forks in raised position. • When not in use, forks lowered, brake set, controls in neutral, key removed. ***Geosyntec Procedure(s):*** *HS-505-Safe Operation of Forklifts, HS-132-Competent Persons*
☐	**AERIAL LIFTS**	☐ See Section B.4., "Fall Hazards" *Geosyntec Procedure(s): HS-509-Aerial Lifts*
☒	**TRENCHING/EXCAVATION** Hazards: Cave-in, hazardous atmosphere, structures & foundations, falls into excavations	☒ <u>Safe work practices when personnel will enter trenches/excavations:</u> • Activities under supervision/oversight of competent person, daily inspection. • Excavated materials placed at least 2' from trench sidewall. • Prevent water accumulation in trench. • Sloping & shoring for excavations ≥20' must be approved by a professional engineer. • Sloping/shoring/trench box for excavations ≥5' when persons enter trench/excavation. • Sloping/shoring/trench box for shallow (<5') excavations with cave-in hazard . • Workers in trenches to be within 25 feet of ladder or sloped entryway. • Excavations to be protected by perimeter fencing (not barricade tape), if potential for personnel to fall into. • If potential for atmospheric hazard, see Section B.10, "Confined Space Entry, Hazardous Enclosed Spaces" ***Geosyntec Procedure(s):*** *HS-402-Excavation and Trenching, HS-132-Competent Persons*
☐	**IMPORTANT!** This work may/will include close proximity to overhead and/or underground utility lines.	☐ Follow safe work practices per Section B.9., "Utility Related Hazards"
☐	**DEMOLITION**	☐ Develop/implement demolition safety plan. ***Geosyntec Procedure(s):*** *HS-132-Competent Persons*
☐	**BLASTING**	☐ Develop/implement blasting safety plan. ***Geosyntec Procedure(s):*** *HS-307-Blasting and Use of Explosives, HS-132-Competent Persons*

☐	**PUBLIC AT RISK, SITE SECURITY**	☐ During site operations protect public (overhead protection, barriers, warning signs). ☐ During off hours, protect public with barriers, warning signs/lights, other measures as appropriate. ☐ Lock/secure hazardous materials and/or equipment.

B.8. ELECTRICAL HAZARDS ☒ Applicable ☒ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☒	**BASIC ELECTRICAL HAZARDS TO SKILLED NON ELECTRICAL WORKERS** Equipment/tool use/operation, use of extension cords, working near electrical equipment. Hazards: Electrical shock, secondary hazards (falls, other injuries).	☒ Follow safe work practices: • Control water-related/wet-location hazards in a manner appropriate for the job tasks/equipment/tool. • Never touch electrical equipment if you are wet, or standing in water or on wet surfaces. • Use extension cords/power cords properly, prevent damage, take out of service if damaged. • Inspect tool/equipment/extension cords/power cords/welding cables before each use; do not use if damaged. • Use GFCI-protected outlet or portable GFCI in wet locations, outdoors, basements, concrete floors. • Ensure live parts are guarded, enclosures secure. • Enclosures, circuits properly labeled. ***Geosyntec Procedure(s):*** *HS-121-Electrical Safety*
☐	**HANDS-ON ELECTRICAL WORK BY ELECTRICAL WORKER/TECHNICIAN:** ☐ Voltage < 50 v ☐ Voltage 50-600v ☐ Voltage > 600v ☐ AC ☐ DC ☐ 3-phase ☐ Battery and/or solar power ☐ Capacitor/transformer	☐ Implement electrical safe work practices pertaining to: • Worker training/qualification (Level 1, Level 2, Level 3) • General electrical safe work practices, grounding, use of GFCIs • Safe work practices during diagnostics/troubleshooting, maintenance, repair • Safe design features for electrical equipment • Arc flash protection ***Geosyntec Procedure(s):*** *HS-121-Electrical Safety, HS-129-High Voltage Electricity Safety*
☐	**LOCKOUT/TAGOUT OF ELECTRICAL ENERGY**	☐ Implement control-of-hazardous-energy practices (lockout/tagout), provide lockout/tagout locks and devices, training workers, designate "authorized" personnel, notify "affected" personnel. ***Geosyntec Procedure(s):*** *HS-119-Lockout Tagout, HS-121-Electrical Safety*
☐	**IMPORTANT!** This work may/will include close proximity to electric utility lines.	☐ Follow safe work practices per Section B.9., "Utility Related Hazards"

B.9. UTILITY RELATED HAZARDS ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☐	**OVERHEAD, ABOVE-GROUND UTILITIES**	☐ Maintain proper clearance, employ other appropriate precautions for the conditions. ***Geosyntec Procedure(s):*** *HS-304-Overhead Electrical Lines*
☒	**UNDERGROUND UTILITIES**	☒ Confirm appropriate underground utility clearance procedures have been completed prior to ground penetrations, and employ other utility clearance/locator practices, as appropriate for conditions. ☒ Hand digging or vacuum post-holing within 3' of utility locations or other high risk condition.

B.10. CONFINED SPACE ENTRY, HAZARDOUS ENCLOSED SPACES ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☒	**CONFINED SPACE(S)** Potential/actual hazards: ☐ Atmospheric hazards: ☒ Flammable/explosive ☒ Oxygen deficiency ☐ Hydrogen sulfide ☒ Other toxic ☐ Combustible dust ☐ Electrical ☐ Mechanical, engulfment, entrapment, stored energy	☒ Develop effective site-specific entry procedure **per applicable regulatory requirements**: • Personnel to be trained/qualified. • Hazards properly characterized • Use equipment necessary for safe entry (for access, retrieval, PPE, air monitoring, ventilation) • Develop measures for emergency rescue, as applicable. • IMPORTANT: - Describe site-specific safety measures above in Explanatory Notes, Clarifications - Modify this THA or attach separate confined space safety plan/permit, as appropriate ☒ Protect non-entry personnel working near confined spaces thru control measures to prevent unauthorized entry (such as safety orientation, labeling, delineation, barriers)

		Geosyntec Procedure(s): *HS-111-Air Monitoring, HS-112-Respiratory Protection, HS-113-Personal Protective Equipment, HS-118-Confined Space Entry, Others as applicable*
☒	**HAZARDOUS ENCLOSED OR INDOOR SPACE(S)** ☐ Indoors (occupied or vacant) ☐ Machine/equipment pit/vault ☐ Basement/crawl space ☐ Tunnel, shaft, gallery ☒ Trench, excavation ☐ Hazardous exhaust or emissions ☐ Building-related hazards	☒ Use personal protective clothing to protect from chemical, physical, biological hazards. ☒ Use respiratory protection, if necessary/appropriate. ☐ Duct equipment exhaust to outdoors using passive duct or active exhaust ventilation. ☒ Use fans, blowers or other effective means of ventilation to introduce fresh air/dissipate atmospheric hazards. ☒ Conduct air monitoring, as appropriate for conditions and hazards (see Part C, "Air Monitoring"). ☒ For a trench/excavation, also see subsection entitled "Trenching/Excavation" in Section B.7. "Construction, Heavy Equipment, Lift Equipment." ☒ If space classified/regulated as a "confined space," follow confined space entry requirements (above). ***Geosyntec Procedures****: HS-111-Air Monitoring, HS-112-Respiratory Protection, HS-113-Personal Protective Equipment, Others as applicable*

B.11. STORAGE OF BULK MATERIALS ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☒	**STORAGE OF BULK MATERIALS** (for Storage of Hazardous Materials, See Section B.13.)	☒ Store materials in stable manner (stacked, racked, blocked, interlocked, tied, wrapped, or otherwise secured) to prevent tipping, sliding, rolling, falling or collapse. ☒ Do not exceed load limits of racks, platform, scaffold; ensure racks are stable, robust, secure. ☐ Ensure stored materials do not block aisles, passageways.

B.12. INFECTIOUS / ALLERGENIC BIOHAZARDS ☐ Applicable ☒ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

☐	☐ Wastewater, sewer ☐ Bird Guano ☐ Mold, fungi, Valley Fever ☐ Bloodborne pathogens ☐ Other (describe above)	☐ Low hazard - use basic hygiene practices, protective gloves, provide for hand washing. ☐ More severe hazard - add protective clothing, respirator/dust mask, decon, as appropriate. ☐ For human pathogens use "Universal Precautions" per Bloodborne Pathogen Program. ***Geosyntec Procedure(s):*** *HS-133-Bloodborne Pathogens*

B.13. COMMERCIAL CHEMICAL PRODUCTS ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS: Buried drums contain possibly unknown chemicals. Drums may or may not be labeled.

☒	**PRODUCTS REGULATED BY HAZARD COMMUNICATION STANDARD**	☒ Safety Data Sheets available, either on site or readily available within same work shift, containers labelled properly, workers trained/oriented on hazards ☒ For subcontractor use of chemical products, coordinate/discuss during safety meetings. ☒ Conduct air monitoring, as appropriate (see Part C, "Air Monitoring, Worker Exposure Monitoring").
☐	**COMPRESSED GAS (flammable or nonflammable)**	☐ Secure cylinders upright, caps on when not in use, handle with care, prevent damage. ☐ Propane cylinders not in use must be stored outdoors in cage or similar secure enclosure. ☐ Ensure acetylene cylinders NOT secured to steel arc welding bench. ☐ Store/use in a manner to prevent asphyxiation hazard. ☐ Segregate oxygen and fuel gases by distance (20') or barrier. ☐ Control ignition sources. ☐ "No smoking" signage at cylinder storage area for flammable gases. ☐ Use/store in a manner to control inhalation exposure hazards, PPE, air monitoring.
☒	**FLAMMABLE/COMBUSTIBLE LIQUIDS**	☐ Proper storage (flam. storage cabinets, other storage precautions). ☐ Use proper fuel safety can (metal fuel can preferred). ☒ Control ignition sources. ☐ Grounding and bonding where appropriate.
☐	**ACIDS, CAUSTICS, OTHER CORROSIVES**	☐ Handle with care, use appropriate eye/face/skin protection. ☐ Eyewash, deluge shower, drench hose, hand washing (with water), as appropriate.

☒	**TOXIC**	☒ For toxic substances, use/store in a manner to control exposure hazards (inhalation, ingestion, skin contact, skin absorption); use PPE as appropriate, conduct air monitoring as appropriate.
☒	**EMISSIONS FROM FUEL COMBUSTION, INDUSTRIAL PROCESSES** ☐ Gasoline ☒ Diesel ☐ Propane/Natural Gas ☐ Welding/cutting/hot work ☒ Vehicle/equipment exhaust ☐ Other	☒ Position outdoor personnel upwind of exhaust source. ☐ Use blowers, fans to provide fresh air to work area and dissipate atmospheric hazards. ☐ Use respiratory protection for high levels of smoke, exhaust particulates, soot. ☒ Conduct air monitoring as appropriate (see Part C, "Air Monitoring").
☒	**OTHER HAZARDS**	☒ Describe other hazardous substances and safety measures under "Explanatory Notes, Clarifications," above.
☒	**CHEMICAL/HAZMAT STORAGE** Check this when jobsite requirements include special provisions for chemical storage.	☐ Chemical storage cabinet, cage, storage room, or similar. ☐ Ensure incompatible chemicals are segregated. ☒ Provide secondary containment. ☒ Locate special safety equipment near chemical storage

Geosyntec Procedures: *HS-115-Hazard Communication, HS-111-Air Monitoring, HS-112-Respiratory Protection, HS-113-Personal Protective Equipment, HS-114-Safety Training Programs, Others as applicable*

B.14. SITE CONTAMINANTS, CHEMICAL WASTES ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS: Drums are to be excavated 1 at a time. If drum integrity is compromised, contents will be pumped into a new drum. Drums will be temporarily stored in a HDPE lined containment area. Geosyntec will follow the perimeter air monitoring program installed by PSC. Metals were detected in groundwater, but are not expected to be encountered during this task.

CHECK ALL THAT APPLY. Provide explanatory notes above.

☒ Soil/groundwater contaminants (historical release) ☐ Recent release, known high concentrations ☒ Former chemical disposal site, landfill ☐ Urban fill, residual contaminants ☒ Containerized waste (drums, process equipment) ☒ Buried drums (known or potential) ☒ Large containers, potential for spills ☐ Contaminated building surfaces ☐ Unexploded ordnance ☐ Explosive dust	☐ Oxygen deficiency ☒ Chlorinated volatile organic compounds (VOCs) ☒ BTEX, petroleum derived VOCs ☐ Fuel oils, petroleum, waste oil, lubricants ☒ Metals, metal compounds, metal dusts ☐ Elemental mercury ☐ Polyaromatic hydrocarbons (PAHs) ☐ Polychlorinated biphenyls (PCBs) ☒ Potential for flammable vapors ☐ Potential for flammable gas (methane)	☐ Corrosive, acids/caustics, strong irritants ☐ Sulfides, hydrogen sulfide (H_2S) ☐ Cyanides, hydrogen cyanide (HCN) ☐ Asbestos ☐ Lead paint ☐ Pesticides, herbicides, fungicides ☐ Sensitizers ☐ Radioactive contaminants ☐ Other (see Explanatory Notes, above)

☒ **FOR WORK CONSISTING OF CLEANUP OPERATIONS, CORRECTIVE ACTIONS, PRELIMINARY INVESTIGATIONS at an "UNCONTROLLED HAZ. WASTE SITE" (per HAZWOPER, 29 CFR 1910.120), implement the following as applicable to the work:**

- Implement site control plan via Exclusion Zone(s), Contaminant Reduction Zone(s) and Support Zone (aka EZ, CRZ, SZ)
- Workers to be aware of and trained on hazards per OSHA Hazard Communication Standard.
- Include site map/figure depicting work locations and other relevant site-specific information.
- Site workers in EZ or CRZ to have OSHA 40-hour training, current 8-hour refresher, 3 days supervised field experience.
- Site supervisor(s) required to have 8-hr. Supervisor training.
- Site workers in EZ or CRZ to participate in Medical Monitoring program, as applicable.
- Implement site-specific procedures for worker protection via engineering controls, work practices, personal protective equipment (PPE), air monitoring, decontamination procedures, spill containment, emergency preparedness and response.
- Conduct air monitoring, as appropriate (see Part C, "Air Monitoring, Worker Exposure Monitoring").

IMPORTANT: Provide supplemental information to sufficiently detail site-specific procedures for the above elements, as appropriate for the work.

Geosyntec Procedures: *HS-301-HAZWOPER, HS-108-Medical Monitoring Surveillance, HS-111-Air Monitoring, HS-112-Respiratory Protection,*

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☒ Air Sampling *(sample collection, passive dosimeter)* ☐ Wipe/Bulk Sampling *(to evaluate worker exposure)*	☐ Ionizing or Non-ionizing Radiation Testing ☐ Noise Testing	☐ Heat Stress Testing ☐ Other
EXPLANATORY NOTES, CLARIFICATIONS:		
Geosyntec Procedures: *HS-109-Hearing Protection, HS-111-Air Monitoring, HS-124-Heat Stress Prevention, HS-126-Radiation Safety Program, HS-128-Ionizing and Non-ionizing Radiation, HS-601-Asbestos, HS-602-Lead*		

PART D – APPROVALS, ACKNOWLEDGEMENTS

D.1. THA PREPARATION, REVIEW/APPROVAL SIGNATURES - THA typically prepared by project staff, reviewed/approved by Project Manager, Supervisor, qualified/knowledgeable designee, with support of HS personnel as deemed appropriate by the Project Manager.			
	Printed Name	*Signature*	*Date*
THA PREPARED BY: (minimum one person)	Patrick Medland		11/7/2017
	Printed Name	*Signature*	*Date*
THA REVIEWED/ APPROVED BY: (minimum one person)	Thomas J. Krasovec		11/7/2017

D.2. FIELD CREW ACKNOWLEDGEMENTS

GEOSYNTEC FIELD CREW

Please sign below to acknowledge you reviewed and understand this THA, participated in project safety briefing and had an opportunity to ask questions about the information herein.

Printed Name	Signature	Employee No.	Date

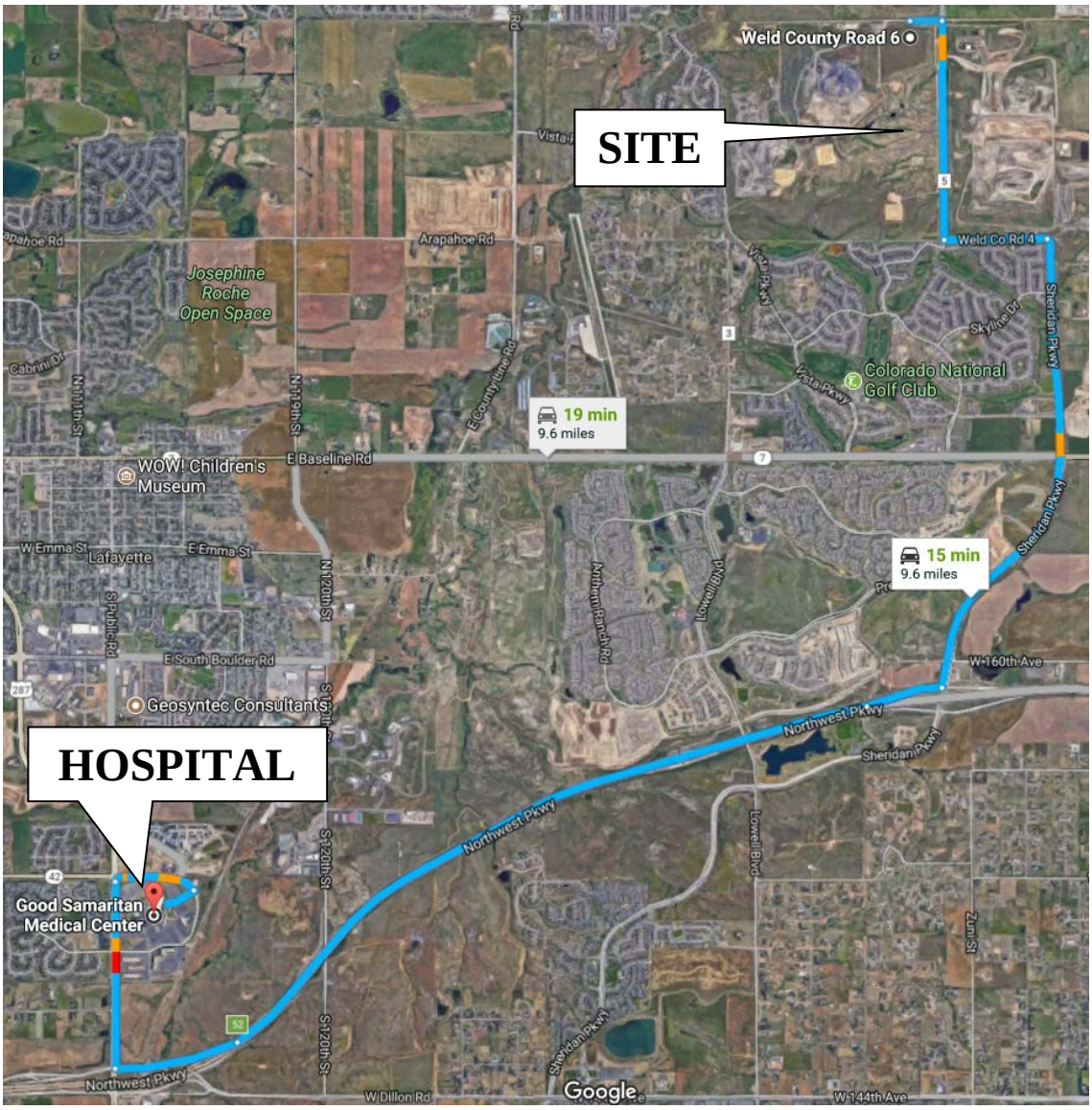
SUBCONTRACTOR'S FIELD CREW

Please sign below to acknowledge that this THA was made available to you, and you had an opportunity to ask questions about the information herein.

Printed Name	Signature	Company Name	Date

ROUTE TO HOSPITAL and/or URGENT CARE FACILITY

- ROUTE TO HOSPITAL



Good Samaritan Medical Center

303-689-4000

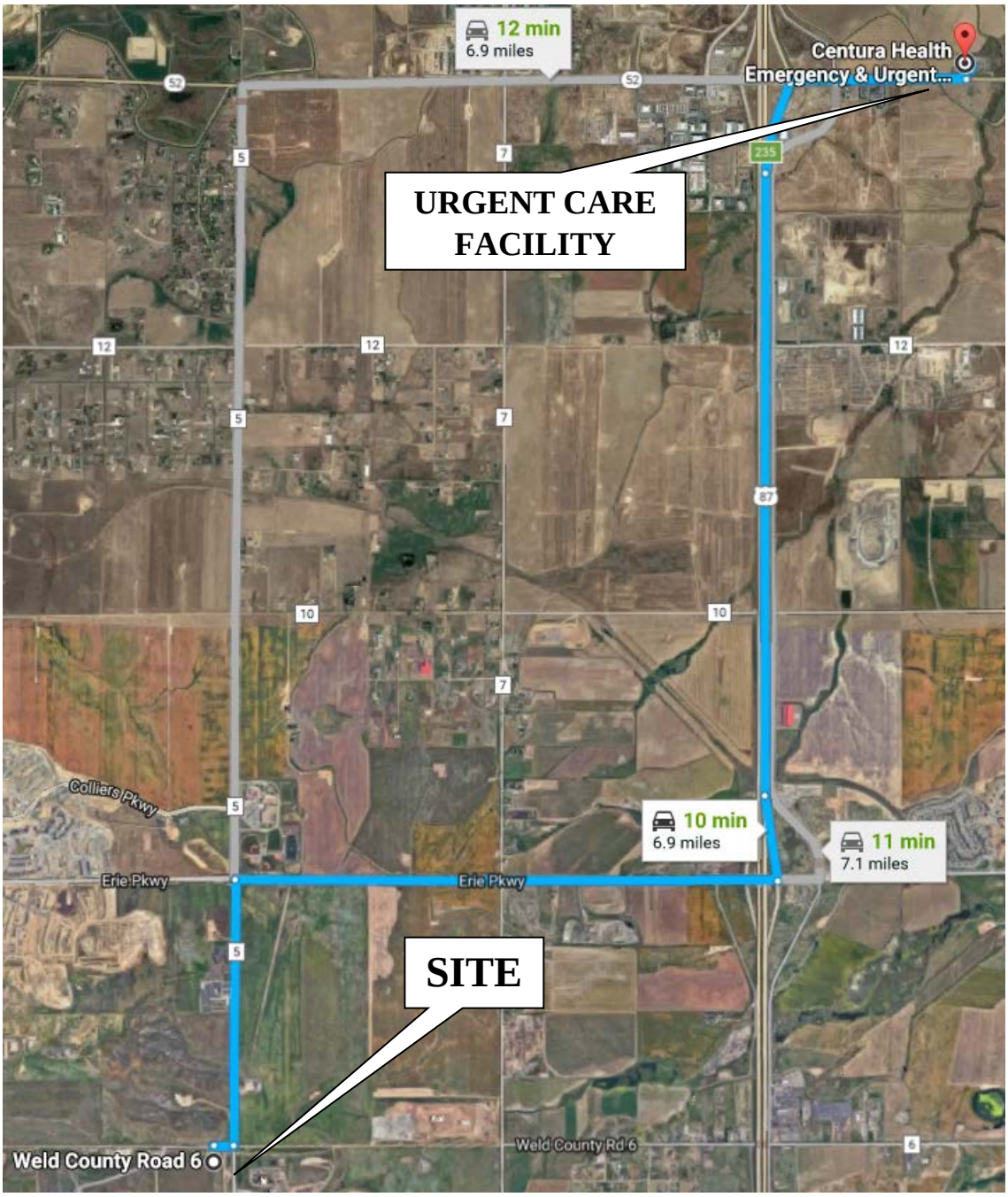
200 Exempla Circle

Lafayette, CO 80026

DIRECTIONS TO HOSPITAL FROM SITE

- Head south on Co Rd 5
- Turn left onto Weld Co Rd 4 (0.5 mi.)
- Weld Co Rd 4 turns right and becomes Sheridan Pkwy (2.3 mi.)
- Turn right onto the ramp and merge onto the Northwest Pkwy W (3.8 mi.)
- Take exit 52 to merge onto W Dillon Rd toward US-287/Lafayette/Broomfield (0.6 mi.)
- Turn right onto S 112th St (0.9 mi.)
- Turn right onto Exempla Cir (0.4 mi.)
- Hospital is on the right

- ROUTE TO URGENT CARE FACILITY



Centura Health Emergency & Urgent Care - Frederick

(303) 925-4840

4943 Highway 52, Suite 100

Frederick, CO 80514

Note – Urgent care open 7 AM – 9 PM, Emergency care open 24/7.

DIRECTIONS TO URGENT CARE FACILITY FROM SITE

- Head north on Co Rd 5 (1 mi.)
- Turn right onto Erie Pkwy/Weld County Rd. 8 (2.0 mi.)
- Turn left onto Interstate 25 N ramp and merge onto I-25 (2.7 mi.)
- Take exit 235 for CO-52 toward Dacono/Ft. Lupton (0.4 mi.)
- Turn right onto CO-52 E/State Hwy 52 E (0.7 mi.)
- Urgent Care is on the left

Appendix C: Summary of Chemical Hazards

Petroleum Hydrocarbons

Petroleum hydrocarbons likely at the site include tar and/or fuel-related materials in soils and sediments. Gasoline, diesel, oil, and heavier hydrocarbons, such as grease, may be present. Volatile components of gasoline include benzene, toluene, ethylbenzene, and xylenes (BTEX).

The primary exposure routes for petroleum hydrocarbons during site activities are inhalation, dermal contact, and ingestion of contaminated soil, sediment, dust, or water. Lighter petroleum hydrocarbons such as gasoline and benzene readily volatilize and are primarily an inhalation concern, whereas the primary route of exposure to heavier petroleum hydrocarbons such as aromatic hydrocarbons, oil, and grease is dermal contact. The target organs primarily affected by prolonged exposure to petroleum hydrocarbons are the respiratory system, central nervous system, kidneys, liver, and skin. Prolonged dermal contact with petroleum hydrocarbons can cause irritation or dermatitis. The BTEX compounds are known or suspected human carcinogens.

Petroleum hydrocarbons such as gasoline are also flammable and can be a physical hazard when present in high concentrations. Combustion of petroleum hydrocarbons can produce carbon dioxide, carbon monoxide, aldehydes, fumes, smoke (particulate matter) and other products of incomplete combustion. Intentional and inadvertent combustion of petroleum hydrocarbons is not expected during sampling activities; however, personnel will evacuate the area should a fire occur. The table below summarizes BTEX exposure limits.

Chemical Name	PEL[1]	TLV[2]
Benzene	1	0.5
Toluene	200	20
Ethylbenzene	100	100
Xylene	100	100

[1] OSHA Permissible Exposure Limit (in parts per million)
[2] ACGIH Threshold Limit Value (in parts per million)

Chlorinated Solvents/Volatile Organic Compounds (VOCs)

Chlorinated VOCs are widely used as solvents in industrial operations such as degreasing, manufacturing, cleaning and dry cleaning, and are also present in household products and automotive fluids. They readily form vapors which can accumulate in indoor air spaces (i.e., via migration through the subsurface) and react with ozone to form sub-micron sized particles with the potential to cause adverse respiratory health effects. Free product releases (via surface or subsurface discharges or inadequate disposal) can migrate downward to significant depths and through fine-grained deposits to groundwater, and can persist as wide-scale sources of vapor plumes for long periods of time.

Several chlorinated hydrocarbons have been identified in soil, indoor air vapor, and groundwater at the site including perchloroethylene (PCE), trichloroethylene (TCE), ,1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cis-1,2-DCE), vinyl chloride, 2-butanone (methyl ethyl ketone – MEK), methylene chloride, and tetrahydrofuran. The likely routes of exposure to chlorinated solvents include inhalation, ingestion and direct contact with the skin or eye. The toxicity of chlorinated solvents varies; many affect the CNS and some are identified as carcinogens. For example, PCE can affect the CNS and cause irritation of the skin, eyes, and upper respiratory tract. TCE can depress the CNS, affect kidneys, liver, and lungs and can cause rapid and irregular heartbeat. Toxic effects are increased when combined with alcohol, caffeine, and other drugs. TCE is a flammable liquid; the LEL is approximately 6% and the flash point is less than 100°F. PCE is not considered flammable. These chlorinated solvents are only slightly soluble in water.

Exposure levels will be maintained below OSHA PEL or NIOSH REL as shown in the table below.

Chemical Name	PEL[1]	REL[2]
cis-1,2-DCE	200	200
1,1-DCE	NL	Ca
TCE	100	Ca
PCE	100	Ca
Vinyl chloride	1	Ca
2-butanone (MEK)	200	200
Methylene chloride	100	Ca
Tetrahydrofuran	200	200

[1] OSHA Permissible Exposure Limit (PEL) in parts per million
[2] NIOSH Recommended Exposure Limit (REL) in parts per million
NL = Not listed
Ca = Carcinogenic

RCRA Metals

These metals include arsenic, barium, cadmium, chrome, mercury, selenium, and silver. Heavy metals are known to cause neurologic effects (lead, mercury), kidney damage (cadmium), and respiratory damage (arsenic, cadmium). Oral and respiratory exposures should be minimized.

Acids/Bases

Strong acids and bases (such as hydrochloric acid, nitric acid, sodium hydroxide, potassium hydroxide) are potentially present at the site.

Such substances expose the personnel to the following risks:

* Irritations and caustic injuries (chemical burns). Acids and bases, have a noxious power which varies in strength with the tissue these substances come in contact with. Some compounds (for example sodium hydroxide) may be responsible for very bad injuries to the skin, the eyes and, in case of accidental ingestion, to the upper digestive system. Furthermore, irritating gases and vapors (such as gaseous chlorine) may develop during different reactions.

* Acute intoxications. Intoxication may occur as a result of accidental ingestion or inhalation or, less frequently, as a result of skin contact.

* Chronic intoxications.

These may arise as a consequence of prolonged exposure to relatively small doses, unable to produce acute effects. The most frequently reported toxic effects include liver disease, nephropathy, coagulation disorders and nervous system disorders.

Appendix D: Air Monitoring

Applies to Task: ☒ ① ☐ ② ☐ ③ ☐ ④ ☐ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧

☒ *Photoionization Detector (PID)*

Brand/Model No.: **MiniRAE 3000 (or similar) eV: 10.6**

Monitoring Frequency: **At least every 30 minutes during field activites or continuous**

Breathing Zone Reading (ppm)	Action
0 to 5	Level D PPE
5 to 50	Level C PPE
Greater than 50	Stop work. Evacuate the area. If upon return, levels still exceed the action level, stop work and implement engineering controls.

Note: _____

☒ *Oxygen (O_2) Meter*

Brand/Model No.: **5 Gas Meter**

Monitoring Frequency: **Continuous**

Reading (%)	Action
Less than 19.5	Stop work. Evacuate the area.
19.5 to 23.0	Continue to work with caution.
Greater than 23.0	Stop work. Evacuate the area.

Note: _____

☒ *Explosimeter*

Brand/Model No.: **5 Gas Meter**

Monitoring Frequency: **Continuous**

Source (% LEL)

Reading	Action
0 to 5	Continue with caution.
Greater than 5	Stop work. Evacuate the area. If upon return, concentration still exceeds 5% LEL, ventilate until concentration is back to <5% LEL.

Note: _____

☐ *Flame Ionization Detector (FID)*

Brand/Model No.: **TVA2020 (or similar)**

Monitoring Frequency: **At least every 30 minutes during field activites or continuous**

Breathing Zone Reading (ppm)	Action
0 to 5	Level D PPE
5 to 50	Level C PPE
Greater than 50 _____	Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls.

Note: _____

☐ *Chemical Detector Tube*

Brand/Model No.: _____

Monitoring Frequency: _____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than __ _____	Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls.

Note: _____

☐ *Other*

Brand/Model No.: _____

Monitoring Frequency: _____

Breathing Zone Reading	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than __ _____	Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls.

Note: _____

Appendix E: Personal Protective Equipment

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Level per Task:	☒ D ☒ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C

Modified Level D		***Level C***	
Equipment	***Material/Type***	***Equipment***	***Material/Type***
☒ Safety glasses		☐ Full-face air-purifying respirator	Cartridge Type:
☒ Hard-toed boots		☒ Half-mask air-purifying respirator	Cartridge Type: P100 / OV
☒ Protective clothing		☒ Safety glasses	
☒ Hard hat		☒ Hard-toed boots	
☒ Hearing protection		☒ Protective clothing	
☒ High-visibility vest		☒ Hard hat	
☐ Outer boots		☒ Hearing protection	
☐ Outer gloves		☒ High-visibility vest	
☐ Other:		☒ Outer boots	
		☒ Outer gloves	
		☒ Inner gloves	
		☒ Other: Coveralls	

Geosyntec Personnel shall wear Level C PPE when in the Exclusion Zone. Level D PPE can be worn in the Support Zone and CRZ. Geosyntec Personnel shall not enter the excavation area near drums of unknown materials where Level B PPE is required.

Appendix F: Geosyntec Health & Safety Procedures

1. Excavation and Trenching
2. Respiratory Protection Program
3. Unknown Hazardous Waste Drum Handling
4. Heavy Equipment
5. Confined Space Entry
6. Asbestos

US Health & Safety Procedures

Excavation and Trenching

1.0 PURPOSE

Geosyntec will evaluate job-related excavation operations to confirm proper protective systems have been installed prior to entry and ensure employee protection from excavation collapse. In addition, Geosyntec will comply with the guidelines found in 29 CFR Subpart P, 1926.650 through 1926.652, as well as any state or local regulations. This procedure applies to all of the subsidiaries, affiliates, and operating units of the Geosyntec family of companies (hereinafter referred to as "Geosyntec" or the "Company") in the US. Any exceptions to this procedure must be approved, in writing, by the Health and Safety (H&S) Director.

2.0 GENERAL REQUIREMENTS

The following factors are to be evaluated by a competent person and discussed before commencing entry into excavations:

Soil Structure: Excavations in wet soil, sandy soil, or areas that have been backfilled are relatively unstable and must be supported or sloped if employees are to enter the excavation.

Weather Conditions: Changing weather conditions greatly affect the safety of working in and around excavations. Excess water from rain or snow loosens the soil, increasing the chance of the soil caving in. Excavation should be diked, pumped, or covered, to prevent an excessive amount of water from accumulating.

Superimposed Loads: Superimposed loads in the vicinity of excavation walls increase the probability of a cave-in. Heavy equipment and materials from subcontractor activities should be kept back as far as possible. Heavy equipment should be placed on wooden mats or planking to spread the weight more evenly. Considerations must also be taken when buildings, curbs, trees, utility poles, and other structures are near the excavation. Excavated soil must be stored away from the edge of the excavation.

3.0 SPECIFIC REQUIREMENTS

The following safe operating guidelines will apply to excavations exceeding 4 feet in depth.

- Prior to performing an excavation, all efforts shall be made by Geosyntec and/or its subcontractors to determine and locate both overhead and underground utilities prior to excavation activities. The utilities shall be marked and/or identified and discussed at the morning safety meeting. Project management shall contact the One-Call Center for the state in which the excavation is to be performed to obtain written clearance. For excavation operations outside the United States, contact the local utility companies for clearance. For locations that are not covered by One-Call Centers or local utility companies (i.e., client specific utilities), clearance must be obtained from the client. In addition to obtaining utility clearances, the appropriate party will conduct a utility survey at each defined excavation. Documentation that nearby utilities have been marked on the ground and any overhead utilities have been clearly identified and that the excavation site has been cleared shall be maintained in the project log book and trailer/support vehicle and communicated to the subcontractor performing the excavation. All utilities shall be

identified on a job hazard analysis and communicated to all excavation and heavy equipment support personnel.

- Trees, boulders, and other surface encumbrances that create a hazard will be identified and/or isolated before entry into an excavation.
- Geosyntec employees will ensure subcontractors store and retain excavated materials at least 2 feet away from the edge of the excavation.
- Except in hard rock, Geosyntec personnel will not enter excavations that are below the level of the base of the footing of any foundation or retaining wall unless the wall is underpinned and all other precautions have been taken to ensure the stability of the adjacent walls.
- Employees subjected to vehicle traffic in excavating operations shall don reflective clothing.
- Excavations shall be inspected by a Geosyntec competent person prior to company personnel entering the space to perform sampling, QA/QC, etc.
- When employees are required to work in an excavation 4 feet or deeper, one or more ladders shall be provided for access/egress. Within the trench, the maximum horizontal travel distance to a ladder shall be no more than 25 feet. The ladder shall extend a minimum of 3 feet above the excavation and be secured. This ladder shall not be removed until all employees have exited the excavation. All ladders will meet the requirements of 29 CFR 1926.1053.
- Excavations deeper than 5 feet which are entered by Geosyntec employees shall be sloped, shored, or supported by some other protective system by the subcontractor prior to entering the space.
- Subcontractors will place guardrails or fences at all excavations which are close to sidewalks, drives, or other thoroughfares. Adequate protection shall also exist at remote excavations where workers are not present.
- Employees working and/or sampling around an excavation deeper than 4 feet will be protected from the fall hazard by an appropriate fall protection measure (e.g., warning line, barricade, fencing, etc.).

4.0 PROTECTIVE SYSTEMS

OSHA requires that all excavations more than 5 feet deep, which will be entered by employees shall be shored, sheeted, braced, or supported.

- The preferred method is for the subcontractor to slope the sides of the excavation to the angle of repose, or the angle of control at which the soil will remain at rest. The angle of repose varies with different kinds of soil; this angle must be determined on each individual excavation, using the following guidelines:

Maximum Allowable Slopes

Soil or Rock Type	Horizontal to Vertical Ratio (Slope)	
Stable Rock	Vertical	(90 degrees)
Type A	¾:1	(53 degrees)
Type B	1:1	(45 degrees)
Type C	1½:1	(34 degrees)

Note: No soil classification is required if a 1½:1 slope (34-degree slope) is used. If a 1½:1 slope is not used, a soil classification must be made by a competent person. The excavation must then comply with the above minimum slope requirements.

- The second method of support is shoring, sheeting, tightly placed timber shores, bracing, trench jacks, piles, or other materials installed in a manner strong enough to resist the pressures surrounding the excavations.
- The third method is for the subcontractor to use a trench box, which is a prefabricated movable trench shield made of steel plates, welded to a steel frame.

5.0 HAZARDOUS ATMOSPHERES

When Geosyntec performs activities in excavated areas where a hazardous atmosphere could reasonably exist (e.g., landfill, hazardous storage areas, underground/aboveground storage tanks, etc.) personnel will, at a minimum, apply these guidelines:

- Perform atmospheric testing in the anticipated breathing zone of the work area to determine oxygen content, combustible gas, and toxic gases and vapors, if applicable.
- Employees will not perform work in areas with less than 19.5% oxygen without the appropriate respiratory protection or adequate ventilation.
- Employees will not perform work in an area with more than a 10% lower explosive level (LEL).
- Toxic gases will be evaluated on a per-site basis using direct-reading equipment.

6.0 COMPETENT PERSON

Prior to the entrance to any excavated area reaching a minimum depth of four (4) feet below ground surface or as designated in the project Health and Safety Plan (HASP), the Project Manager must identify a "Competent Person" (CP) who meets the requirements identified below to serve on-site during all activities conducted in and adjacent to excavated areas. The H&S Department will approve individuals that will serve as Geosyntec's CP for all activities conducted in excavated areas. The qualifications and responsibilities of the CP include:

Qualifications:

- Completed a Geosyntec-approved Excavation Competent Person training course;
- Completed a review of the applicable Geosyntec H&S Standard Operating Procedures (SOP) and site-specific HASP with the H&S Department; and
- Has demonstrated sufficient experience to identify existing and predictable hazards in the excavation and its surroundings.

Responsibilities:

- Identify potential, predictable and existing hazards associated with an excavation and/or its surrounding area(s) that needs to be entered and/or evaluated during work activities;
- Authorized to take prompt corrective measures to eliminate potential hazards;
- Perform a daily inspection of the excavation with the subcontractor using the Excavation Daily Inspection Checklist or equivalent (**see Attachment 1**).
- Evaluate and verify the soil classification of the excavation.
- Evaluate and verify that the protective system selected by the subcontractor (if implemented) is adequate for Geosyntec operations.
- Ensure that operational safety practices conform to those identified in this Procedure and any additional federal, state, or local requirements; and

- Be onsite during all operations and activities where Geosyntec personnel are working in and/or around an excavation that is four (4) or more feet in depth or as required by the project HASP.

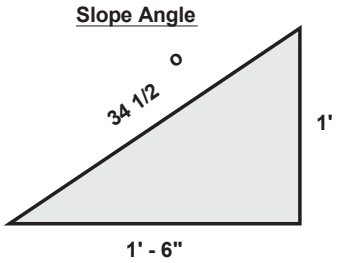
7.0 ATTACHMENTS

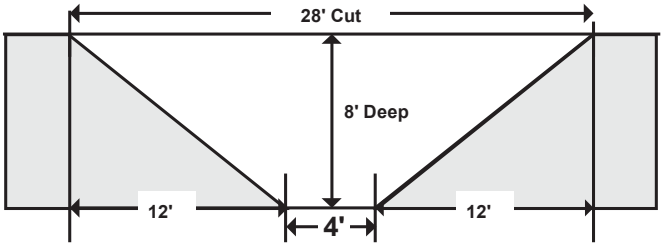
Attachment 1 – *Excavation Daily Inspection Checklist*

ATTACHMENT 1

Daily Excavation Checklist			
Competent Person:	Date:		
Site Location:	Project Number:		
Soil Type: Excavation Depth:	Excavation Width:		
Type of Protective System Used:			
Indicate for each item: Yes – No – or N/A for not applicable:			
1. General Information:	**Yes**	**No**	**N/A**
A. Is excavation less than five feet in depth?			
B. Is there a potential for a cave-in? ***IF YES, excavation must be sloped, shored, or shielded.**			
C. Is excavation deeper than five feet in depth? *** IF YES, excavation must be sloped, shored, or shielded.**			
D. Is sloping used as your protective system?			

Slope information to keep in mind:





Example of a Simple 34-degree Slope commonly used around the site for cave-in protection.

2. Inspection of Job Site:			
A. Excavations, adjacent areas, and protective systems inspected by a competent person daily before the start of work.			
B. Competent person has the authority to remove employees from the excavation immediately.			
C. Surface encumbrances removed or supported.			
D. Employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation.			
E. Hard hats and safety glasses worn by all employees.			
F. Spoils, materials, and equipment set back at least two feet from the edge of the excavation.			
G. Adequate barriers provided at all excavations, wells, pits, shafts, etc.			
H. Warning vests or other highly visible clothing provided and worn by all employees exposed to vehicular traffic and heavy equipment.			
I. Employees required to stand away from vehicles being loaded or unloaded.			
J. Warning system established and utilized when mobile equipment is operating near the edge of the excavation.			
K. Employees prohibited from going under suspended loads.			
3. Utilities:			
A. Location of utilities marked.			
B. Prior to the use of equipment, underground utilities have been located by hand digging. Are any overhead power lines within 20 feet of the excavation?			
C. Underground utilities are protected, supported, or removed when excavation is open.			
D. Are there any manhole covers, water valve covers, concrete christy boxes, or other flush-mounted monuments denoting electrical or other utilities in the vicinity?			

Daily Excavation Checklist Continued:			
4. Means of Access and Egress:	**Yes**	**No**	**N/A**
A. Travel distance to means of egress no greater than 25 feet in excavations four feet or more in depth.			
B. Straight ladders used in excavations extend at least three feet above the edge of the trench.			
C. Ramps being used for employee access have been designed by the competent person.			
D. Employees protected from cave-ins when entering or exiting the excavation.			
5. Wet Conditions:			
A. Precautions have been taken to protect employees from the accumulation of water.			
B. Water removal equipment monitored by a competent person.			
C. Surface water or runoff diverted or controlled to prevent accumulation in the excavation.			
D. Inspections have been made after every rainstorm or other hazard-increasing occurrence.			
6. Hazardous Atmosphere: **The atmosphere within the excavation must be tested where there is a reasonable possibility of an oxygen deficiency, combustible or other harmful contaminant exposing employees to a hazard.**			
A. Are there exposed sewer or natural gas lines in excavation?			
B. Is excavation near a landfill area, or are hazardous substances being stored close to the excavation?			
If you answered YES to A or B, then treat excavation as a confined space. **See Confined Spaces Procedure.**			
7. Support Systems:			
A. Materials and/or equipment for support systems selected based on soil analysis, trench depth, and expected loads.			
B. Materials and equipment used for protective systems inspected and in good condition.			
C. Materials and equipment not in good condition have been removed from service.			
D. Protective systems installed without exposing employees to the hazards of cave-ins, collapses, or threat of being struck by materials or equipment.			
E. Members of support system securely fastened to prevent failure.			
F. Support systems provided to ensure stability of adjacent structures, buildings, roadways, sidewalks, walls, etc.			
G. Excavations below the level of the base of a footing have been approved by a Registered Professional Engineer.			
H. Removal of support systems progresses from the bottom and members are released slowly so you can note any indication of possible failure.			
I. Backfilling progresses with removal of support system.			
J. Excavation of material to a level no greater than two feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.			
K. Shield system placed to prevent lateral movement.			
L. Employees are prohibited from remaining in shield system during vertical movement.			
8. Training:			
A. All employees have had Excavation Safety Awareness Training.			
B. Supervisor and/or Site Health and Safety Office (SHS) have had the Excavation Competent Person Training.			

1.0 SUMMARY

The Respiratory Protection Program (RPP) established in this Procedure complies with the requirements in 29 CFR 1910.134 and describes the requirements for respirator selection, medical surveillance needs, respirator use, cleaning, maintenance, storage, inspection, and fit testing. This procedure applies to all Geosyntec offices and project locations in the US.

Project/location/facility specific requirements for use of respiratory protection will be specified through the development of site specific respiratory protection programs developed in accordance with this general program. **Attachment 1** provides a template that, when used in conjunction with this general RPP, will provide adequate documentation.

2.0 SELECTION OF RESPIRATORY PROTECTION

Operational safety documentation (e.g., Health and Safety Plans [HASPs), permit-required confined-space entry procedures, Task Hazard Analyses, etc.) must be utilized to specify respiratory protection requirements.

Selection of the specific type of respiratory protective equipment, including appropriate cartridges/canisters for air-purifying respirators, must be approved by the H&S Department or *other safety professional* approved by the Geosyntec H&S Director. Actual selection of this equipment will be performed in compliance with 29 CFR 1910.134 or applicable state-plan standards.

In general, the selection of equipment will take into consideration the following variables:

1. **Nature of respiratory hazard**. Consideration must be given to the specific nature of the respiratory hazard, including:
    a. *Contaminant concentration*. If the airborne contaminants concentrations are unknown, air-purifying respirators are NOT approved. Air purifying devices are approved for use in atmospheres containing specific contaminants at levels up to specifically designated concentrations.
    b. *Physical and chemical properties of the contaminant(s)*. If the contaminant or mixture exists in different physical states (gas, vapor, mist, dust, fume), the respirator must provide protection for all forms. An air purifying device may require a chemical sorbent and particulate filter for adequate protection. The presence of two or more incompatible contaminants that might react in the cartridges or canisters would exclude the use of air-purifying devices.
    c. *Warning properties*. Air purifying respirators are approved only for contaminants that have "adequate warning properties" to warn the respirator user when breakthrough or facepiece leakage occurs. A substance is considered to have adequate warning properties when:
        - Its odor, taste, or irritant effects are detectable and persistent at concentrations below the safe exposure level.

- Its odor or irritation threshold is less than 3 times the safe exposure level, but no ceiling limits exist, and no serious or irreversible health effects occur within the concentration range.
- Oxygen deficient atmospheres and IDLH concentrations. Air purifying devices will not provide protection for oxygen deficient environments (less than 19.5 percent oxygen) or IDLH concentrations. Only Self-Contained Breathing Apparatus (SCBA) or approved air supplied units are approved for this use.

2. **Characteristics of hazardous operation or process**. Consideration must be given to the specific nature of the hazardous operation or process, including:

   a. Location of the process or operation with respect to a safe area having respirable air.

   b. The activity of the workers in the hazardous area (for example, whether the worker is in the area continuously or intermittently during the work shift and whether the workload is light, medium, or heavy).

   c. Contributory or intermittent operations, such as periodic maintenance to process vessels, sampling of containerized waste, addition of treatment chemicals, etc., that could alter contaminant generation rates.

   d. Modification of the operation or process (both authorized and unauthorized changes) that could change the respirator requirements.

   e. Relative humidity greater than 65% may impair the effectiveness of air purifying respirators.

3.0 GENERAL REQUIREMENTS

3.1 Medical and Physical Requirements

Employees who are required to utilize respiratory protection shall be medically evaluated to ensure that they are able to wear respirators prior to being included in the RPP - this includes fit testing the individual. Medical surveillance for respiratory protection shall be performed on an annual basis as part of Geosyntec's employee medical surveillance program. A written evaluation on each employee's ability to wear respirators, and limitations, if any shall be available at the project/facility/location as part of the site specific RPP.

3.2 Respirator Use

To provide protection from inhalation of airborne contaminants, respirators must be properly used. The following use requirements shall be adhered to at all times:

1. Respiratory protection utilized to prevent exposures to toxic chemicals must only be used when accepted engineering controls are not feasible. Administrative controls (i.e., worker rotation) are not considered an accepted control measure to reduce exposures.

2. In areas where an employee, because of a failure of a respirator, could be overcome by a toxic or oxygen deficient atmosphere, at least one additional person shall be present. Communications (voice, visual, or signal line) shall be maintained between all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and he/she will have the necessary rescue equipment to assist the others in case of emergency.

3. The actual use of all respiratory protective equipment shall conform to the manufacturer's operating instructions and training provided to the employee. A copy of all operating

instructions for each type of equipment shall be maintained at the facility/office/project and be able to be reviewed by any employee required to use the equipment.

4. All parts supplied with the respirator (including the air hose that connects to the respirator) are specifically approved as a unit. Removal or interchanging of different parts voids the National Institute of Occupational Health (NIOSH)/Mine Safety and Health Administration (MSHA) approval. **Under no circumstances shall respirators be modified to void the approval.**

5. Only the employee to whom a respirator was issued, and who has been fit tested, shall use each respirator.

6. Only employees who have been trained, fit tested, and medically qualified in accordance with the provisions of this RPP shall wear respirators.

7. Negative pressure respirators shall not be worn where conditions prevent a good seal. This includes:
   a. Where facial hair interferes with the seal and/or operation of the respirator. Employee's face must be clean-shaven prior to donning the respirator for use or fit testing. Beards, stubble beard growth, sideburns, goatees, handlebar mustaches, and similar facial hair features are not permitted to cross the respirator-sealing surface.
   b. Scars that may cause leakage between the face and facepiece.
   c. Glasses with temples, since the temples will pass between the face and face piece. Spectacle kits will be provided for wearers of prescription lenses, or the use of contact lenses is acceptable inside full-face masks.
   d. Any other condition that prevents a good seal, such as donning a respirator after putting on a hood, and the hood protrudes into the sealing area. Any type of apparel that interferes with a satisfactory fit shall be altered or removed.

8. Employees shall not wear personally-owned respirators when performing work.

9. Personnel shall inspect the respirator prior to each use to ensure that it is not defective.

10. Areas where respirators must be worn shall be posted indicating respirators are required so that inadvertent entry by unprotected personnel will be prevented.

11. Respirators shall be cleaned and stored after each use in accordance with this RPP. In order to accomplish this task, a respirator cleaning station will be set up in a location designated in the site specific RPP. This station may include the following items to assist in the cleaning process: respirator wipes, buckets, brushes, water, respirator cleaning soap/disinfectant, and drying area.

12. Respirators shall be stored in a clean, plastic, resealable bag when not in use.

13. Respirators shall be stored in such a way as to prevent face piece distortion, and protect it from crushing and scratching.

3.3 Inspection of Respiratory Protection Equipment

A respirator must be inspected prior to each use to ensure that it is operational and without defect. The following items must be inspected during each pre-use inspection:

1. Check the overall mask shape to ensure that the respirator has not been deformed.

2. Check the straps to ensure they have maintained their elasticity, and that the clips are operational.

3. If feasible, remove the cover to the exhalation valve (typically located on the bottom outside of the respirator), pull the exhalation valve away from the seat (to ensure it is not stuck), and check for tears or improper seating (from particulate interference or change in shape of the valve). Place the exhalation valve cover back on.

4. For full-face respirators, check the lens to ensure that it is not scratched or clouded to prevent proper vision during wearing.
5. Turn the respirator over. Check the outside sealing area of the respirator to ensure there are no cracks, and that the respirator has maintained its shape.
6. APRs - Remove each cartridge, and remove the gasket (if so equipped). Check both sides of each cartridge gasket to ensure that there are no cracks or indentations that would cause a leakage point.
7. APRs - Check the underside of each cartridge to ensure that the elevated portion that seals on the gasket (or face piece if there is no gasket) is not dented, which would allow leakage.
8. APRs - Replace old/used cartridges with new the cartridges.
9. APRs - Look inside the respirator and find the inhalation valves (one per cartridge). Check to make sure they are not stuck and that they lay properly.
10. SARs - Check all hoses for kinks and holes.
11. SARs – Examine the regulator to ensure it is operational.

If during the inspection a defect is found, the respirator MUST be placed out of service in accordance with established project/facility/location procedures. Obtain a new one. Go through the inspection procedure for the new respirator.

3.4 Respirator Cleaning and Maintenance

Respirators shall be cleaned after each use. Use a cleaner/disinfectant that is made for respirator cleaning. **Under no circumstances should any alcohol-containing cleaner be used as alcohol may damage the lens and the rubber components of the respirator.** After cleaning, store the respirator in a clean Ziploc® bag (or equivalent), ensuring nothing is stored on top of the respirator, which could crush or damage it.

The only on-site maintenance allowed for respirators is the changing of cartridges, and inspection of the respirator for defects, and cleaning. Only personnel specifically trained can perform replacement of respirator parts.

Requirements for replacement of cartridges must be specified in the site specific RPP.

3.5 Training

Each respirator wearer shall be provided formal training prior to being required to use respiratory protective equipment. Employees who have not had formal respirator training within the previous 12 months shall be provided with refresher training prior to utilizing respiratory protective equipment.

Training will normally be provided in two distinct steps: General and Site Specific. The General Training will include:

1. The provisions of this procedure and OSHA Standard 29CFR1910.134
2. Employee responsibilities within the respirator program.
3. Respirator selection criteria.
4. Respirator issue procedures.
5. Inspection of respirators.
6. Cleaning/maintenance.

7. Discussions of the types of jobs that personnel may perform that require respirators, the hazards for which respirators would be required, and the typical types of respirators.

The Site Specific training will include:

1. Provisions of the site specific RPP
2. Specific use, care, maintenance and storage procedures
3. Opportunity to handle and use the required respiratory protective equipment in a safe environment.
4. Specific communication and emergency provisions

4.0 AIR PURIFYING RESPIRATORS

The following requirements shall apply to all use of air purifying respirators by Geosyntec personnel:

1. Only full-face, negative pressure air purifying respirators are acceptable for use unless specific authorization is provided by the H&S Department.
2. It is critical that air-purifying respirators have the appropriate cartridges attached for the contaminant(s) of concern; otherwise, the respirator will not protect the employee.
3. When using air-purifying respirators with chemical cartridges, if an odor is noted, or if irritation results, exit the work area and replace the cartridges.
4. When using air-purifying respirators with particulate filters, replace the filters when breathing becomes difficult.
5. Chemical cartridges shall not be used after the manufacturer's expiration date.
6. Chemical cartridges shall be discarded per the requirements of the approved site specific RPP.
7. Assigned protection factors for the various styles of air purifying respirator are:
   a. Half-face APR – 10.
   b. Full-face APR – 50.
   c. Powered APR (hood or similar flow-through system) – 25.
   d. Powered APR (full-face mask) – 100.

4.1 Training and Fit Testing

During initial respirator training, users of APRs shall be taught the following prior to the issuance of respirators:

1. Cartridge selection criteria.
2. Respirator and cartridge limitations.
3. Respirator use procedures.
4. Cartridge change-out frequencies and indications.

Personnel shall also be fit tested at least annually to determine the manufacturer, model, and size of respirator that best fits. The fit testing shall be accomplished using one of the three accepted qualitative fit test methods (quantitative fit testing may be performed; however, accepted protection factors of respirators will be based solely on qualitative factors specified in the regulation):

1. Irritant smoke.
2. Isoamyl acetate.
3. Bitrex™.

Fit testing will be conducted only by personnel trained in fit testing procedures by the H&S Department (or approved alternate) using the *Geosyntec Fit Test Form* in accordance with the *Geosyntec Accepted Fit Test Procedures* (both attached).

4.2 Donning/Doffing of APRs

Respirators will provide adequate protection only if properly donned. The following are the donning procedures for most air-purifying respirators:

1. Position the respirator on the face; pull the adjustment straps to secure the respirator in the proper location. Do not over tighten.
2. Perform a positive and negative pressure check:

    a. Positive pressure check: Place the palm of your hand lightly over the exhalation valve cover. Lightly exhale. The respirator should lightly push away from your face, with no outward leakage noted between the face and face piece.
    b. Negative pressure check: Place you hands lightly over the cartridges (or end of the hose) to cover the air holes. Inhale and hold your breath. The respirator should lightly collapse on your face, with no inward leakage noted between the face and face piece.

5.0 SUPPLIED AIR RESPIRATORY PROTECTION

NOTE: Prior to use of respiratory protection in Section 5, the H&S Department will discuss the project, scope of work, chemical, physical, and environmental hazards that require this type of protection with the Project Manager and staff. Staff requiring the need for respiratory protection in this section will participate in an extensive training and hands-on exercises prior to wearing the apparatus at a project site and/or during work activities.

The following requirements shall apply to all use of supplied air respiratory protection by Geosyntec personnel:

1. Assigned protection factors for the various styles of supplied air respirator systems are:
    a. Airline system w/full-face mask (demand mode) - 50
    b. Airline system w/full-face mask (pressure demand mode) – 1,000
    c. SCBA system w/full-face mask (demand mode) - 50
    d. SCBA system w/full-face mask (pressure demand mode) – 10,000
2. Airline respirators will not be used with more than 300 feet of airline hose from the respirator to the air source.
3. Airline respirators and SCBAs shall be used only with air that meets the minimum requirement for Grade D air or better, as specified by the Compressed Gas Association.
4. A certificate confirming these requirements will accompany each shipment of Grade D air.

5.1 Self-Contained Breathing Apparatus (SCBAs)

SCBAs are to be used whenever Level A or B protection is required, whenever the site health and safety officer requires their use, or whenever the hazards of a situation cannot be assessed prior to entry. Exceptions based upon site conditions may be granted where the Site Safety Officer has approved an airline respirator with escape pack system.

The Site Safety Officer is responsible to ensure that site personnel using the equipment maintain each SCBA in a ready for use state at all times. This includes performing the monthly inspections and inspecting, sanitizing, and refilling or replacing the air tanks after each use.

Monthly inspections are to include checks on tightness of connections and the condition of the headbands, valves, and connecting tubes. Rubber parts are to be inspected for pliability and deterioration. The air tank must be fully charged and the hydrostatic test certification must be up-to-date (within 3 years for a composite cylinder, 5 years for a steel cylinder). Regulator and warning devices must function properly. A record of inspection dates is to be maintained on the *Monthly SCBA Check Form* (Attachment 2), which will be maintained on the SCBA or in its storage container. The inspection checklists are to be kept with the SCBA for reference. Any deficiency noted during inspection requires removing the SCBA from service until the condition is corrected. The SCBA and the storage case must be clearly marked or tagged "OUT OF SERVICE."

6.0 ATTACHMENTS

Attachment 1 – Site Specific Respiratory Protection Program Template

Attachment 2 – Monthly SCBA Check Form

Attachment 3 – Qualitative Fit Test Form

Attachment 4 – Geosyntec Accepted Fit Test Procedures (Mandatory)

Site-Specific Respiratory Protection Program
For the (INSERT NAME) Site

1.0 Selection of Respiratory Protection

All respiratory protection used by Geosyntec personnel must be selected according to 29 CFR 1910.134. The implementation of this program will be under the direct supervision of (**Insert Name of local RPP coordinator**). In order to simplify this procedure for field implementation, the following action levels have been determined for this project:

Specific Equipment	Action Level/Monitoring	Activity/Location
Examples:		
MSA Ultra-Twin w/ organic vapor cartridges)	0-5 ppm above background on PID	Test Pit Number 12
Scott SCBA	>5 ppm on chlorine alarm	Chlorination Room 2

2.0 Use of Respiratory Protection

Based on the site-specific chemical hazards and the anticipated site activities, the following respiratory protection is anticipated to be used at this project.

Activity/Location	Respiratory Protection Anticipated

Based on actual and anticipated site specific conditions, the following cartridge change-out schedule(s) have been calculated when using air-purifying respirators:

Cartridge/Canister (make and model)	Activity/Location	Change-Out Frequency

The change-out frequency table above was determined by (insert name of H&S Department or equivalent) and the calculations can be reviewed at (insert location).

All personnel onsite must be properly fit-tested for each type of equipment they may be required to use. The personnel qualified to perform this testing are (insert name of qualified fit tester(s).

The records of all fit tests for site personnel are maintained and can be reviewed at (insert location).
Training records for respiratory protection may be reviewed at (insert location).

The following respiratory protective equipment has been assigned to specific individuals:

Employee Name	Equipment Type/Number	Size

Medical clearance records for users of respiratory protection can be reviewed at (insert location).

A copy of all operating instructions for each type of equipment may be reviewed at (insert location).

A respirator-cleaning station has been set up at (insert location(s). This station includes the following items to assist in the cleaning process:

Equipment Included

The following instructions will be posted at the respirator cleaning station to ensure adequate cleaning and disinfection:

Respirator Type	Step-by-Step Cleaning Instructions

3.0 Respirator inspection

In addition to inspecting ALL respiratory protective equipment prior to use, these additional inspections will be conducted and documented:

Equipment	Frequency	Responsible Party

4.0 Respirator storage

All respiratory protection utilized by Geosyntec employees must be stored in a convenient, clean, and sanitary location and according to specific manufacturer recommendations. Special attention must be paid to protecting respiratory protection from dusty conditions, temperature extremes, and potential contamination during storage.

The following storage procedures will be utilized for equipment used on a routine basis (i.e., storage during non-use periods of a work shift or storage between work shifts):

Equipment	Storage Procedures

All equipment not routinely used will be stored according to the procedures outlined below:

Equipment	Storage Procedures/Location

Any equipment not assigned to specific site personnel will be stored under the supervision of (insert name) following the procedures outlined below:

Equipment	Storage Procedures/Location

5.0 Surveillance of Work Area

Appropriate monitoring of the work area conditions shall be performed to establish the degree of employee exposure or stress. In order to simplify this surveillance, the following procedures have been determined for this project:

Monitoring Equipment Used	Frequency of Surveillance	Personnel/Area Monitored

Records of the above surveillance will be documented in accordance with Geosyntec's Recordkeeping Procedures.

6.0 Program Evaluation

There will be regular inspections and evaluations (at least monthly) to determine the continued effectiveness of this program. Documentation will be maintained by (insert name), and can be reviewed at (insert location).

This RPP will be reviewed and updated whenever deficiencies are noted during monthly inspections or annually, whichever is more frequent.

7.0 Approvals

Project Manager:	Date:
(Print Name)	
Site RPP Coordinator:	Date:
(Print Name)	
H&S Department	Date:
(Print Name)	

Monthly SCBA Check Form

Month	Unit No.	Inspector's Initials	Pass / Fail	Corrective Action(s) Needed	Date(s) Corrected

The following shall be checked on each SCBA during each monthly inspection:

1) Check the overall shape of each facepiece to ensure it has not been misshapen.
2) Check the respirator straps to ensure they maintain their elasticity, and that the clips are operational.
3) Remove the cover of the exhalation valve (if possible), and make sure the valve rests properly and is not dirty or cracked/bent.
4) Check all hoses for kinks and holes.
5) Check the facepiece to ensure that the lens is not scratched or clouded to prevent proper vision during wearing.
6) Check straps of the harness to ensure they are not cracked or rotted.
7) Turn on airflow and check to ensure that the bottle is full and that air is flowing.
8) Turn off air and verify that the low-air alarm is operational.

Comments:

Geosyntec consultants

Qualitative Respirator Fit Test

Name:	Employee ID#:
Org. No.:	Home Office:
Tester Inspection of Respirator: ☐ Passed	☐ Failed
Comments:	
Method: ☐ Irritant Smoke	☐ Other:
Sensitivity Check before Donning Respirator: ☐ Passed	☐ Failed
Respirator Manufacturer:	**Size:** **Model:**
Is Respirator Comfortable? ☐ Yes ☐ No	
If No, Explain:	
Does employee wear glasses or contacts?	
Have inserts been provided? ☐ Yes ☐ No ☐ N/A	
Are inserts worn during this test? ☐ Yes ☐ No ☐ N/A	
Face Seal Checks:	
☐ Visual ☐ Negative Pressure	☐ Positive Pressure
Fit Test Procedure (perform each for 1 minute)	
☐ Pos/Neg Leak Check	☐ Nod Head
☐ Breathe Normally	☐ Talking (read the Rainbow Passage)
☐ Breathe Deeply	☐ Bend Over
☐ Turn Head	☐ Breathe Normally
Sensitivity Check after Doffing Respirator: ☐ Passed	☐ Failed
Rainbow Passage:	
When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.	
Test Given By:	Date:
Signature:	

Geosyntec Accepted Fit-Testing Procedures (Mandatory)

Qualitative fit testing will be conducted using the following procedures:

1. The most acceptable respirator will be chosen to correctly fit the user and provide an acceptable comfort level.
2. Provide instructions to employee on donning respirator, positioning, strap tension, and acceptable fit. A mirror should be available to assist in donning a respirator. The employee should assess the respirator for comfort and fit. This instruction does not constitute formal training on respirator use.
3. If the employee is not familiar with using a respirator, they will be directed to don the mask several times and adjust the straps each time to become adept at setting proper tension on the straps.
4. The following criteria shall be used to help determine the adequacy of the respirator fit: Chin placement; strap tension; fit across nose bridge; respirator of proper size to span distance from nose to chin; tendency of respirator to slip; self-observation in mirror to evaluate fit and respirator position.
5. Conduct a user seal check, both negative and positive pressure seal checks. Before conducting the negative and positive pressure checks, the employee will seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. If pressure checks are failed, reposition the mask to attain a better fit. If mask continually fails, another respirator may need to be selected.
6. The fit test will not be conducted if facial hair is present; the employee must be clean-shaven.
7. Medical clearance to wear a respirator must be conducted prior to fit testing an employee.
8. Prior to the fit test, the employee will be given a description of the fit test and their responsibilities during the test. The description shall include examples of the test exercises that the employee will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.
9. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use that could interfere with respirator fit.
10. Test Exercises. The following exercises will be conducted standing in place during the fit test, except (G).
    a. Normal breathing: Without talking, breathe normally.
    b. Deep breathing: Breathe slowly and deeply, taking caution so as not to hyperventilate.
    c. Turning head side to side: Turn head from side to side. Hold the head at each side, inhaling at each side.
    d. Nod head up and down: Move head up and down. Inhale and exhale in both the up and down positions.
    e. Talking: Talk slowly and to be heard by the test conductor. Read from a prepared text such as the rainbow passage, ABCs, or recite a memorized poem or song (see Qualitative Respiratory Fit Test Form for text of the “Rainbow Passage”).
    f. Grimace: Grimace by smiling or frowning.
    g. Body Movement: Bend over to touch toes, or jog in place.
    h. Normal breathing: Without talking, breathe normally.

Each test exercise shall be performed for one minute except for the grimace exercise, which shall be performed for 15 seconds. The employee will be questioned by the test conductor regarding the comfort of the respirator upon completion of the fit test. If it has become unacceptable, another model of respirator can be tried. The respirator cannot be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

US Health & Safety Procedures

Unknown Hazardous Waste Drum Handling

1.0 PURPOSE

Drums containing unknown materials, or damaged drums containing hazardous materials, must be handled in accordance with the following procedures.

2.0 SCOPE

This procedure applies to all operations involving the handling, sampling, packaging, or removal of drums, regardless of size, whose contents are poorly understood or completely unknown.

3.0 PROCEDURE

3.1 PLANNING

Because drum handling introduces the potential for danger, every step of the operation should be carefully planned, based on all available information. The results of a preliminary inspection can be used to determine: (1) if any hazards are present and the appropriate response, and (2) whether drums need to be moved in order to be opened and sampled. A preliminary H&S plan should be developed that specifies the procedures based on the hazards associated with the probable drum contents as determined by visual inspection. This plan should be revised as new information is obtained during drum handling.

3.2 AIR MONITORING

Continuous air monitoring is required during the initial evaluation and handling of unknown/hazardous waste drums. Readings will be collected in the breathing zone and general work area. Readings will be collected at a minimum for organic vapors, combustible gas (% LEL), oxygen (% oxygen), and radiation. Action levels will be specified in the Health and Safety Plan (HASP). During initial monitoring, when materials are not adequately characterized, or if drums/containers are leaking and/or ruptured, Level B personal protective equipment (PPE) will be worn by site personnel.

3.3 HANDLING

The purpose of drum handling is to: (1) respond to any obvious problems that might impair worker safety, such as radioactivity, leakage, or the presence of explosive substances; (2) unstack and orient drums for sampling; and (3) if necessary, to organize drums into different areas onsite to facilitate characterization and remedial action. Handling may or may not be necessary, depending on how the drums are positioned at a site.

Since accidents occur frequently during handling, particularly initial handling, drums should be handled only if necessary. Prior to handling, all personnel should be warned about the hazards of handling and instructed to minimize handling by using remote methods. In all phases of handling, personnel should be alert for new information about potential hazards. Personnel should respond to new hazard information before continuing with routine handling operations.

Overpack drums, which are larger drums that contain leaking or damaged drums for storage or shipment (see 49 CFR Part 173.3(c)), and an adequate volume of absorbent should be kept near areas where minor spills may occur. In these areas, a containment berm adequate to contain the entire volume of liquid in the drums should be constructed prior to any drum handling. If drum contents spill, personnel trained in spill-response procedures should isolate and contain the spill.
Several types of equipment can be used to move drums: (1) A drum grappler attached to a hydraulic excavator; (2) a small front-end loader, which can be either loaded manually or equipped with a bucket sling; (3) a rough-terrain forklift; (4) a roller conveyor equipped with solid rollers; and (5) drum carts designed specifically for drum handling. Sometimes drums are moved manually. The drum grappler is the preferred piece of equipment for drum handling. The grappler distances the operator from the drums so there is less likelihood of injury if the drums detonate or rupture. If the drum is leaking, the operator can stop the leak by rotating the drum and immediately placing it into an overpack. In case of an explosion, grappler claws help protect the operator by partially deflecting the force of the explosion.

The following procedures are to be used to maximize worker safety during drum handling and movement:

- Train personnel in proper lifting and moving techniques to prevent back injuries.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads and can operate smoothly on the available road surface.
- Air condition vehicle cabs to increase operator efficiency; protect the operator with heavy splash and/or blast shields.
- Supply operators with appropriate respiratory protective equipment when needed. Normally, a combination self-contained breathing apparatus (SCBA)/supplied-air respirator (SAR) with the air tank fastened to the vehicle or an airline respirator and an escape SCBA are used because of the high hazard potential of drum handling. Respiratory equipment improves operator efficiency and provides protection in case the operator must abandon the equipment.
- Have overpacks ready before attempting to move drums.
- Determine the most appropriate sequence for moving the various drums and other containers. For example, it may be necessary to move small containers first in order to move larger drums or to permit heavy equipment to enter the area.
- Exercise extreme caution in handling drums that are not intact and tightly sealed.
- Ensure that operators have a clear view of the roadway when carrying drums. If necessary, station ground workers to guide the operator's motion.

3.3.1 Buried Drums

- Prior to initiating subsurface excavation, use ground-penetrating systems to estimate the location and depth of the drums.
- Remove soil with great caution to minimize the potential for drum rupture.
- Keep a dry chemical fire extinguisher on hand to control small fires.

3.3.2 Drums Containing Radioactive Waste

If the drum exhibits radiation levels above background, immediately contact the H&S Department for guidance. Do *not* handle any drums that are determined to be radioactive before consulting individuals with expertise in this area.

3.3.3 Drums that May Contain Explosive or Shock-Sensitive Waste

- If a drum is suspected to contain explosive or shock-sensitive waste as determined by visual inspection, seek specialized assistance before handling.
- If handling is necessary, handle these drums with *extreme caution*.
- Prior to handling these drums, move all nonessential personnel a safe distance away.
- Use a grappler unit constructed for explosive containment for initial handling of such drums.
- Place drums on pallets prior to transport. Secure drums to pallets.
- Use an audible siren signal system, similar to the type used in conventional blasting operations, to signal the commencement and completion of explosive waste-handling activities.
- Maintain continuous communications with the Site Safety Officer and/or the command post until drum-handling operations are complete.

3.3.4 Bulging Drums

- Pressurized drums are extremely hazardous. Wherever possible, do not move drums that are internally pressurized, as evidenced by bulging or swelling.
- If a pressurized drum must be moved, whenever possible, handle the drum with a grappler unit constructed for explosive containment. Either move the bulged drum only as far as necessary to allow seating on firm ground or carefully overpack the drum. Exercise extreme caution when working with or near potentially pressurized drums.
- Pressure may be released using remote methods. Contact the assigned project safety professional or the H&S Department to develop specific steps to accomplish this task. The following methods may be used:
    - <u>Tube and spear device</u>. A light aluminum tube (3 meters long) is positioned at the vapor space of the drum. A rigid, hooking device attached to the tube goes over the chime and holds the tube securely in place. The spear is inserted in the tube and positioned against the drum wall. A sharp blow on the end of the spear drives the sharpened tip through the drum and the gas vents along the grooves. Venting should be done from behind a wall or barricade. This device can be cheaply and easily designed and constructed. Once the pressure has been relieved, the bung can be removed and the drum sampled.
    - <u>Hydraulic device</u>. A piercing device with a metal point is attached to the end of a hydraulic line and is pushed into the drum by hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head of the drum. Some metal piercers are hollow or tube-like so that they can be left in place and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.
- Protect personnel by keeping them at a safe distance from the drums being opened. If personnel must be near the drums, place explosion-resistant plastic shields between them and the drums as protection in case of detonation. Locate controls for drum-opening equipment, monitoring equipment, and fire-suppression equipment behind the explosion-resistant plastic shield.
- Use the following remote-controlled devices for opening drums:
    - Pneumatically operated impact wrench to remove drum's bungs.
    - Hydraulically or pneumatically operated drum piercers.

    - Backhoes equipped with bronze spikes for penetrating drum tops in large-scale operations.

- Do *not* use picks, chisels, or firearms to open drums.
- Perform all steps slowly. Relieve excess pressure prior to opening and, if possible, from a remote location using devices such as a pneumatic impact wrench or hydraulic penetration device. If pressure must be relieved manually, place a barrier, such as explosion-resistant plastic sheeting, between the worker and bung to deflect any gas, liquid, or solids that may be expelled as the bung is loosened.

3.3.5 Leaking, Open, and Deteriorated Drums

- If a drum containing a liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for liquid transfer.
- Using a drum grappler, immediately place the following damaged drums in overpack containers:
    - Leaking drums that contain sludges or semi-solids.
    - Open drums that contain liquid or solid waste.
    - Deteriorated drums that can be moved without rupture.

3.4 OPENING

Drums are usually opened and sampled in place during site investigations. However, remedial and emergency operations may require a separate drum-opening area. Procedures for opening drums are the same regardless of location. To enhance the efficiency of drum-opening operations and the safety of personnel, the following procedures should be instituted.

- If a supplied-air respiratory protection system is used, place a bank of air cylinders outside the work area and supply air to the operators via airlines and escape SCBAs. This practice enables workers to operate in relative comfort for extended periods of time.
- If possible, monitor continuously while drums are being opened. Place monitoring equipment sensors, such as colormetric tubes, dosimeters, radiation survey instruments, explosion meters, organic vapor analyzers, and oxygen meters as close as possible to the source of contaminants (i.e., at the drum opening).
- Hang or balance the drum-opening equipment to minimize worker exertion.
- Open exotic metal drums and polyethylene or polyvinyl chloride-lined (PVC-lined) drums through the bung by removal or drilling. Exercise extreme caution when manipulating these containers.
- Do *not* open or sample individual containers within laboratory packs.
- Reseal open bungs and drill openings as soon as possible with new bungs or plugs to avoid explosions and/or vapor generation. If an open drum cannot be resealed, place the drum into an overpack. Plug any openings in pressurized drums with pressure-venting caps set to a 5-psi (pounds per square inch) release to allow venting of vapor pressure.
- Decontaminate equipment after each use to avoid mixing incompatible wastes.

3.5 DRUM SEGREGATION AND STAGING

Drums and containers used during the cleanup will meet the appropriate U.S. Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), and U.S. Environmental Protection Agency (USEPA) regulations for their respective wastes.

Unlabeled drums and containers will be considered to contain hazardous substances and will be handled accordingly until the contents are positively identified and noted on the label.

Before moving drums or containers, employees with the transfer operation should be warned of the potential hazards associated with the contents of the drums or containers and should review the latest site information and risk analysis forms. In congested areas where drums are staged, Geosyntec or subcontractor personnel will use forklifts to move drums to minimize abrasions, pinch hazards, etc.

Prior to handling or moving any containers, the condition of each drum will be noted and appropriate handling procedures discussed with the Project Manager. Drums will be marked to indicate acceptability for handling. Specific locations for drum staging will be constructed during site mobilization. These areas will be equipped with all proper safety and emergency equipment necessary to contain spills and releases. Exact staging locations will be noted on the site plan and incorporated into this HASP using the task risk (job safety) analysis form.

The DOT-specified salvage drums or containers and sizable quantities of proper absorbent and neutralizers (diatomaceous earth, citric acid powder, soda ash, activated carbon, sorbent pads, and boom) will be available and used in areas where spills, leaks, or ruptures may occur.

For major spills or leaks, a customized spill pallet with all necessary tools and equipment will be moved into position. The pallet will contain sorbent media, neutralizing media, tools and equipment, and fire extinguishers. The pallet will be accessible and fully stocked at all times to respond to spills, leaks, or releases during the project.

Drums and containers that cannot be moved without rupture, leakage, or spillage will be emptied into a sound container using a device classified for the material being transferred. Typically, this would be done with an explosion-proof transfer pump or a peristaltic pump. Soil or covering material will be removed with caution to prevent drum or container rupture. Fire extinguishers will be available to control small fires. Personnel will don level B PPE to include Tychem SL® suits and chemical-resistant gloves/booties.

Chemical spills, splashes, and reactions between incompatible chemicals present the greatest risks for exposure in these operations. *The principal routes of exposure are skin contact and inhalation. An emergency eyewash station will be present in the work area.*

4.0 REFERENCES

H&S 404 US – Handling Drums and Large Containers
H&S 405 US – Drum Sampling

1.0 PURPOSE

The following procedure outlines safe working requirements during heavy earth-working equipment operations to comply with 29 CFR 1926 Subpart O and 29 CFR 1926.602. This procedure applies to Geosyntec staff self-performing activities that utilize heavy equipment and is also resource information for Geosyntec Project Managers, site supervisors, and designated health and safety officers involved in projects where subcontractors use such heavy equipment. This procedure applies to all of the subsidiaries, affiliates, and operating units of the Geosyntec family of companies in the US (hereinafter referred to as "Geosyntec" or the "Company"). Any exceptions to this procedure must be approved, in writing, by the Health and safety (H&S) Director.

2.0 DEFINITIONS

Heavy equipment – for this procedure, all excavating equipment and any heavy earthmoving machinery defined in 29 CFR 1926.602(a) (1). These include scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment.

Operator – a person who operates heavy equipment.

Ground personnel/workers – personnel required to perform work on foot near/adjacent to heavy equipment operations (note: operators are considered ground personnel when outside of the equipment cab).

3.0 GENERAL REQUIREMENTS

Field operations that involve heavy equipment represent a significant hazard to ground workers as well as heavy equipment operators. Heavy equipment may cause serious injury or death as a result of rollover, contact with ground personnel, and pinch points. All personnel working at or visiting a site where heavy equipment operations occur shall read and abide by the requirements of this procedure.

3.1 Communications

Communication between site supervisors/managers, heavy equipment operators, and other site personnel is a key method of preventing serious injury or death during heavy equipment operations. The following outlines the communication requirements during heavy equipment operations:

Site supervisors/managers shall ensure that all operators are notified/informed of when, where, and how many ground personnel will be working onsite. Site supervisors/managers shall inform all ground personnel before changes are made in the locations of designated areas.

- If required to work near heavy equipment, ground personnel shall use industry standard hand signals to communicate with operators.

- Always maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.
- All heavy equipment shall be equipped with reverse warning devices (i.e., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a guide shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

3.2 Clearance

Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations. The following outline the clearance requirements during heavy equipment operations:

- Ground personnel shall always yield to heavy equipment.
- Ground personnel shall maintain approximately 100 feet of clearance from all active heavy equipment, unless an approved, job-specific hazard analysis that identifies any special precautions is completed and communicated to the appropriate operators and ground personnel.
- Site supervisors/managers shall designate areas of heavy equipment operation and ensure that all ground personnel are aware of designated areas. Designated areas shall include boundaries and travel routes for heavy equipment. Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
- When feasible, site supervisors/managers shall set up physical barriers (e.g., caution tape, orange cones, and concrete jersey barriers) around designated areas and ensure that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground personnel shall never stand between two pieces of heavy equipment or other objects (i.e., steel support beams, trees, buildings, etc.).
- Ground personnel shall never stand directly below heavy equipment located on higher ground.
- If working near heavy equipment, ground personnel shall stay out of the travel and swing radius areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
- Ground personnel shall never work near heavy equipment during times of inadequate lighting.
- Personnel shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.

3.3 Personal Protective Equipment

At a minimum, all ground personnel and operators outside of heavy equipment shall wear the following:

- **High visibility, reflective safety vest** that is visible from all angles and made of fluorescent material and orange, white, or yellow reflective material (ensure that vest is not faded or covered with outer garments, dirt, etc.).
- ANSI-approved hard hat.
- ANSI-approved safety glasses with sideshields.
- ANSI-approved steel toe safety boots.
- Hearing protection as needed.
- Appropriate work uniform (i.e., full length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

3.4 Utilities

When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc. The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Ensure all equipment (i.e., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath of aboveground utilities.
- Ensure utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work.
- Follow the applicable requirements outlined in H&S 402 US – Excavation and Trenching, and H&S 304 US – Overhead Electrical Lines.

4.0 HEAVY EQUIPMENT REQUIREMENTS

4.1 Training

- Only designated, qualified personnel shall operate heavy equipment.
- Operators shall have all appropriate local, state, or federal licenses or training to operate a designated piece of heavy equipment.
- Operators shall be evaluated through documented experience (resume) and a practical evaluation of skills (field tests). Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

4.2 Inspections and Maintenance

- All heavy equipment shall be inspected and if necessary, repaired prior to use. Operators shall not operate heavy equipment that has not been cleared for use. All machinery and mechanized equipment will be certified to be in safe operating condition (certification form attached) by a competent individual seven days prior to onsite operation, and is valid for one year.
- Heavy equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the site

supervisor/manager immediately. Inspection records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use the Heavy Equipment Pre-Operation Inspection Checklist (Attachment 2).

- Defective heavy equipment shall be immediately taken out of service until repaired.
- Heavy equipment shall be maintained and operated in accordance with the manufacturer's specifications and recommendations (i.e., speed restrictions, load limits, inspections, etc.).
- Never service heavy equipment in an unsafe or hazardous situation (e.g., do not crawl under the raised dump body during an inspection/service of a dump truck).
- Windows and windshields shall be kept free from obstructions and dirt. Windows shall not be cracked or visibly broken. All cab glass shall be safety glass or equivalent that introduces no visible distortion.
- Operators shall keep the cab, deck, rails, steps, and rungs free of grease, oil, mud, ice, and other debris.
- Heavy equipment shall be equipped with overhead protection to guard the operator from falling objects.
- Heavy equipment shall be equipped with a rollover protective structure meeting all OSHA requirements.
- Heavy equipment shall be equipped with seats belts that meet the requirements of the Society of Automotive Engineers Guidelines. Seat belts must be worn while operating heavy equipment.
- Heavy equipment shall be equipped with a tagged, fully charged fire extinguisher.
- Scissor points on front end loaders and other heavy equipment shall be guarded appropriately.

4.3 Operation

- Heavy equipment shall be operated in a safe manner that will not endanger persons or property.
- Heavy equipment shall be operated at safe speeds.
- Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.
- Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.
- When feasible, operators shall travel with the "load trailing," if the load obstructs the forward view of the operator.
- Slow down and sound horn when approaching a blind curve or intersection. Flagmen equipped with 2-way radio communications may be required to adequately control traffic.
- Operators shall remain in cab while heavy equipment is being loaded.
- Always keep heavy equipment in gear while in operation. Do not place in neutral.
- Heavy equipment shall be shut down prior to and during fueling. Do not smoke or use electrical devices while fueling. Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.
- Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended. Also, place all buckets and blades on the ground and place

hydraulic gear in neutral. Heavy equipment parked on slopes shall have the wheels chocked.

- Never jump on to or off of a piece of heavy equipment.
- Never exit heavy equipment while it is in motion.
- Passengers shall only ride in heavy equipment designed for occupancy of passengers.
- Never ride on the outside of a piece of heavy equipment (e.g., tailgates, buckets, steps, etc.).
- Site vehicles must be parked in a safe place away from heavy equipment.
- Operators shall never push/pull “stuck” or “broken-down” equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.
- Operators shall wear seatbelts at all times while operating heavy equipment.
- If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas. During work in exclusion zones where the potential exists for intrusive activities that may unearth unknown materials (i.e., drums, containers, etc.) and/or potentially contact unexploded ordnance (UXO), heavy equipment operations will utilize remote methods, blast shield, and enhanced communications.
- Equipment left unattended at night adjacent to traveled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (or the regulatory requirement for the work location) to the active roadway.
- Pneumatic-tired earthmoving haulage equipment, with a maximum speed exceeding 15 miles per hour, shall be equipped with fenders on all wheels.
- Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not exceeded.
- High lift rider industrial trucks shall be equipped with overhead guards.
- When ascending or descending grades in excess of 5%, loaded trucks shall be driven with the load upgrade.
- All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating or moving parts of equipment shall be guarded when exposed to contact by persons or when they otherwise create a hazard.
- All hot surfaces of equipment, including exhaust pipes or other lines, shall be guarded or insulated to prevent injury and fire.
- All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.
- Platforms, footwalks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.
- Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

4.4 Fueling and Batteries

- Only the type and quality of fuel recommended by the engine manufacturer shall be used.
- A well-ventilated area shall be used for refueling.
- Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.
- No one shall spill fuel on hot surfaces. Any spillage should be cleaned before starting an engine.
- Spilled fuel shall be cleaned with cotton rags or cloths; do not use wool or metallic cloth.
- Open flame, lighted smoking materials, or sparking equipment shall remain well away from the fueling area.
- Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.
- Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.
- The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.
- Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent buildup of a static charge.
- Batteries shall be serviced in a ventilated area while wearing appropriate PPE.
- When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first.
- When installing a battery, the battery shall be connected ground post last.
- When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.
- When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.
- Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water.
- Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention sought immediately.
- To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around battery by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least 25 feet away from battery-charging stations.

5.0 REFERENCES

HS 402 US – Excavation and Trenching
HS 304 US – Overhead Electrical Lines

6.0 ATTACHMENTS

Attachment 1- Certification Form for Machinery and Mechanized Equipment
Attachment 2- Heavy Equipment Pre-Operation Inspection Checklist

ATTACHMENT 1
Certification Form for Machinery and Mechanized Equipment

Project Managers are responsible for ensuring all equipment is certified and that this Machinery and Mechanized Equipment certification form has been submitted by equipment owners.

General Guidelines

Subcontractor equipment shall comply with all applicable requirements for motor vehicles and material handling heavy equipment contained in 29 CFR 1926 Subpart O. Heavy equipment includes, but is not limited to, drill rigs, front end loaders, backhoes, trackhoes, bulldozers, forklifts, and similar equipment used for the implementation of the project Statement of Work.

Equipment Safety Inspections

The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.

- All machinery and mechanized equipment will be certified to be in safe operating condition (using the attached form) by a competent individual seven days prior to onsite operation, and is valid for one year.
- Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.
- Inspections shall include, but are not limited to: all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.
- Drill rigs and related support equipment and vehicles shall be inspected by the driller in charge on a daily basis. These inspections shall be recorded on the Daily Drill Rig Checklist; or on equivalent subcontractor forms.
- Exhaustive preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or the Subcontractor's internal policies, schedules, and equipment SOPs.
- Machinery and mechanized equipment shall be operated only by designated qualified persons.
- Records of tests and inspections shall be maintained at the site by the contractor, and shall be made available upon request of the designated authority, and shall become part of the official project file.
- Equipment not found to be in safe operating condition, or when a deficiency which affects the safe operation of the equipment shall immediately be taken out of service and its use prohibited until safe conditions have been corrected.
- All equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.
- Equipment with an obstructed rear view must have an audible alarm that sounds when equipment is moving in reverse.

TO: Geosyntec DATE:

FROM:

Project Name:

Project Location:

1. This form provides certification of machinery and mechanized equipment to be used on the referenced project for the following work:

Description of equipment work:	
Project Site:	
Subcontractor providing equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and certification of machinery and mechanized equipment, as required by Geosyntec, has been made prior to, but within seven calendar days advance of, use on the project site. Re-certification will be required for equipment that is used on the project site for more than one year.

Identification of equipment (make, model, serial no.)		Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated above, and is CERTIFIED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title	
Company			
Signature		Date	

4. If there are any questions regarding this certification, please contact the following Geosyntec representative:

_____.

Heavy Equipment Pre-Operations Inspection Checklist

ATTACHMENT 2

Project Name/Location:															
Project Number:							Make/Model:						Serial No.:		
Hour meter reading:															
Check the following as appropriate	Operator Name/Date			Operator Name/Date			Operator Name/Date			Operator Name/Date			Operator Name/Date		
	SAT	UNSAT	N/A	SAT	UNSAT	N/A	SAT	UNSAT	N/A	SAT	UNSAT	N/A	SAT	UNSAT	N/A
1. Operator qualified to operate designated piece of heavy equipment															
2. Overhead guard															
3. Horn															
4. Lights (including reverse signaling lights)															
5. Parking brake															
6. Service brakes															
7. Steering															
8. Oil level															
9. Hydraulic oil level															
10. Radiator fluid level															
11. Major fluid leaks															
12. Windows															
13. Backup alarm															
14. Tires (visual)															
15. Seat belts															
16. Fuel leaks															
17. Fire extinguisher full and secure															
18. Fuel lines secure															
19. Electrical lines															
20. Exhaust components															
Comments/Remarks:															

1.0 PURPOSE

Geosyntec personnel will not enter any confined space until it has been evaluated, classified, and (if necessary) has had a specific entry procedure developed. Personnel performing such entries will meet the training and program requirements specified below and in 29CFR1910.146. This procedure applies to all Geosyntec confined space entry projects in the US.

2.0 DEFINITIONS

Confined Space - is a space which:

- Is large enough and so configured that an employee can physically enter and perform assigned work; and
- Has limited or restricted means for entry or exit; and
- Is not designed for continuous human occupancy.

There are two types of confined spaces:

Permit-Required Confined Space (PRCS) – a confined space that exhibits one or more of the following properties:

- Contains or has a potential to contain a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- Contains any other recognized serious safety or health hazard.

Non-Permit Required Confined Spaces (NPRCS) - Spaces that do not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm. These spaces do not require specific entry procedures.

Non-permit-required confined spaces can be designated only by a Certified Industrial Hygienist, Certified Safety Professional, Geosyntec Director of H&S or designee, or Professional Engineer after review of the space(s), historical monitoring data, and other factors (e.g., injuries that have occurred). Therefore, all confined spaces will be considered permit-required unless specifically designated as a non-permit space, in writing, on the approved confined space inventory listing.

Entry – The action by which a person passes through an opening into a confined space. Entry is considered to have occurred as soon as any part of the body breaks the opening of a confined space.

3.0 CLASSIFICATION OF CONFINED SPACES

3.1 Identification of Confined Spaces

All confined spaces under the control of Geosyntec that may be entered will be identified, evaluated and classified on a Confined Space Inventory Listing (Attachment 1 or equivalent). The inventory listing shall be updated as required, at a minimum annually.

3.2 Labeling

1. All permit-required confined spaces will be labeled so that employees are adequately warned of the potential for hazardous conditions/atmospheres. Labeling is not required under the following circumstance:

    a. The spaces are easily recognizable, numerous, and widely spaced (e.g., storm sewer manholes). Employees will be instructed that these constitute confined spaces during required training. However, these locations will be included on the inventory.

    b. A complete inventory has been developed, all personnel have been trained in the use of the inventory, and the workers consult the inventory prior to performance of any work that may require entry into a confined space.

2. When non-permit-required confined spaces require the implementation of confined space entry procedures because of specific work operations (e.g., painting, welding), all entry points will be labeled so as to alert all employees of the existence of the hazardous conditions. These signs will be removed only when the hazard no longer exists (e.g., complete curing of the paint).

3.3 Classification of Confined Spaces

For each identified confined space, an evaluation to determine the nature and extent of all possible hazards to entrants must be conducted. Consideration will be given to the following types of hazards:

- The presence of possible airborne contaminants at concentrations exceeding established occupational exposure limits (OELs).
- The presence of any physical hazards (e.g., electrical shock, mechanical injury, etc.).
- The presence of flammable or explosive conditions.
- The presence of any potential for rapid flooding or engulfment.
- Configurations/positioning that may cause an entrant to become trapped.
- Initial classification as either a PRCS or NPRCS.

The evaluation will be documented using the *Confined Space Hazard Assessment* form found in **Attachment 2.**

Wherever the confined space is controlled by a client or third-party, the controlling entity should be contacted to provide the information necessary to complete the evaluation. However, if Geosyntec personnel are required to enter a confined space owned or controlled by others, the final evaluation will remain the responsibility of responsible Geosyntec Project Manager.

4.0 CONFINED SPACE ENTRY DUTIES

4.1 Entry Supervisor

1. Understand the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

2. Verify following before signing the permit and allowing entry to begin.

    a. Appropriate entries have been made on the entry permit.

b. All tests specified by the permit have been conducted.

c. All procedures and equipment specified by the permit are in place.

d. Means of communication are available and have been tested.

Terminate the entry and cancel the permit when entry operations are complete or when a prohibited condition arises.

Verify rescue services, when required, are available and the means for summoning them are operable.

Remove unauthorized individuals who enter or who attempt to enter the permit space during entry operations.

Ensure that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

Withdraw the entry permit and stop all entries if unsafe conditions are reported during any confined space entry. He/she will not permit same or any other entry until cause of unsafe conditions is thoroughly investigated and Confined Space Program is reviewed to prevent reoccurrence.

4.2 Attendant

1. Understand the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
2. Be aware of the possible behavioral effects of hazard exposure in the Authorized Entrants.
3. Maintain an accurate count of Authorized Entrants in the permit space and ensure the means used to identify Authorized Entrants accurately tracks who is in the permit space.
4. Remain outside the permit space during entry procedures until relieved by another Authorized Attendant.
5. Communicate with Authorized Entrants as necessary to monitor entrant status and to alert Entrants of the need to evacuate the space.
6. Monitor activities inside and outside the space to determine if it is safe for Entrants to remain in the space. Orders the Authorized Entrants to evacuate the permit space under any of the following conditions:
   a. The Attendant detects a problem.
   b. The Attendant detects the behavioral effect of hazard exposure in an Entrant.
   c. The Attendant detects a situation outside the space that could endanger the Entrant.
   d. If the Attendant cannot effectively and safely perform all of his/her assigned duties.
7. Summon rescue and other emergency services as soon as the Attendant determines that Entrants may need assistance to escape from permit space hazards;
8. Take the following actions when unauthorized persons approach or enter a permit space while entry is underway:
   a. Warn the unauthorized persons they must stay away from the permit space;
   b. Advise unauthorized persons they must exit immediately if they have entered the permit space; and
   c. Inform the Authorized Entrants and the Entry Supervisor if unauthorized entrants have entered the permit space.
9. Perform non-entry rescues as specified within this program; and

10. Perform no other duties that might interfere with the Attendant's primary duty to monitor and protect the Authorized Entrants.

4.3 Authorized Entrant

1. Understand the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
2. Properly use personal and facility equipment as required by the entry permit.
3. Communicate with the Attendant as necessary to enable the Attendant to monitor Entrant status and to enable the Attendant to alert Entrants of the need to evacuate the space.
4. Alert the Attendant whenever a recognized warning sign or symptom of exposure to a dangerous situation or a prohibited condition exists.
5. Exit from the permit space as quickly as possible whenever:
    a. An order to evacuate is given by the Attendant or the Entry Supervisor; or
    b. When the Entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or
    c. When the Entrant detects a prohibited condition; or
    d. When an evacuation alarm is activated.

4.4 Rescue Service (if designating an outside service)

Prior to authorizing entry into any confined space, Site (Project) Manager should:

1. Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner (within 3 minutes for life threatening situations or 15 minutes for non-life threatening injuries), considering the hazard(s) identified;
2. Evaluate a prospective rescue service's ability.
3. Select a rescue team or service from those evaluated that:
    a. Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified [as defined in 4.4 (1) above].
    b. Is equipped for and proficient in performing the needed rescue services.
    c. Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and
    d. Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

4.5 Rescue Service (if designating internal rescue team)

Prior to authorizing entry into any confined space, Site (Project) Manager should:

1. Provide affected employees the required personal protective equipment (PPE) and train them in its use.
2. Train affected employees to perform assigned rescue duties.
3. Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR) (at least one member shall hold a current certification in first aid and CPR); and
4. Ensure that affected employees practice making permit space rescues at least once every 12 months.

4.6 Facilitating Non-Entry Rescue

1. Retrieval systems or methods shall be used whenever an authorized entrant enters a permit space (unless the retrieval equipment would increase the overall risk of entry).
2. Retrieval systems shall meet the following requirements:
    a. Each authorized entrant shall use a chest or full body harness with a retrieval line attached at the center of the entrant's back near shoulder level or other suitable locations as appropriate.
    b. The other end of the retrieval line shall be attached to a mechanical device (mandatory for more than 5 feet deep rescue) or fixed point outside the permit space.

5.0 PRCS-Specific Entry Procedures

To protect employees during PRCS entries, and to meet the requirements of 29 CFR 1910.146, Geosyntec-specific PRCS entry procedures will be developed for each PRCS to be entered. Each entry procedure will detail:

- The identity of the PRCS(s) to which the procedure applies.
- Details concerning the potential hazards associated with the entry operation/PRCS.
- Pre-entry preparation:
    - Required air monitoring equipment.
    - PPE.
    - Required emergency response/extraction equipment.
    - Required ventilation procedures (as applicable).
    - Required isolation procedures (as applicable).
    - Rescue agency notification requirements (as applicable).
- Required pre-entry monitoring procedures and applicable at-entry re-classification criteria.
- Air monitoring procedures during entry (if re-classification has not occurred).
- PPE requirements during entry (if re-classification has not occurred).

Specific entry procedures can be documented by following the procedures in sections 5.1 through 5.4 of this procedure and by completing a health and safety plan (HASP), Task Hazard Analysis (THA)/Job Safety Analysis (JSA) in combination with a completed Confined Space Hazard Analysis and Confined Space Permit.

5.1 PRCS Pre-Entry Procedure:

Prior to the start of the entry operation the Entry Supervisor will assign individuals on the entry team to the following jobs:

- Entrant – the person entering the PRCS.
- Primary Attendant[1] - the person dedicated <u>only</u> to assisting the entrant, observing the entry operation and maintaining communications with the entrant throughout the entry procedure.

[1] Note: The Entry Supervisor can serve as the Primary or Secondary Attendant, but <u>cannot</u> perform work as the PRCS Entrant.

- Secondary Attendant for Rescue Procedures - an employee assigned either to specific support of the entry operation or working nearby who can assist with rescue operations in the event of an accident. This person can perform other duties unrelated to observing the entry.

The Entry Supervisor is responsible for ensuring that the individuals assigned to each job fully understand their duties and responsibilities prior to initiating the entry operation. The Entry Supervisor will review the complete entry procedure with all team members prior to the work. The Entry Supervisor will also verify the availability of rescue services.

Additional requirements for Pre-Entry Planning include the following:

- Select the appropriate equipment to measure the potential hazards. Select a multi-gas meter capable of measuring oxygen, combustible gas (%LEL), and other Hazardous Gases.

- Determine the acceptable values for the hazardous conditions being measured, based on the equipment in use and the field calibration method. The action levels are determined as follows:

  - Oxygen 19.5% - 23.5%
  - Lower explosion limit 10%
  - Hydrogen sulfide 5 ppm
  - Carbon monoxide 15 ppm
  - Other toxic chemicals Contact H&S Department

- Ensure all the equipment selected is calibrated, and calibration is still valid.

Personnel trained in accordance with this procedure shall perform field verification of equipment as follows:

1. Calibrate combustible gas meters using appropriate span gas for the detectors to be used. (This span gas calibration shall be performed each time the instrument is turned on).
2. Check detector tube pumps for leakage using the manufacturer's procedures.
3. Calibrate Photo Ionization Detectors (PID) using isobutylene, or other material, in accordance with the manufacturer's directions.
4. Calibrate any other instrumentation to be used in accordance with manufacturer's directions.

Set up barricades around the space being entered as required.

Set up required rescue or retrieval systems.

Institute required lockout/tagout procedures (i.e. electrical, steam, liquid flow-pipe blanking)

Ensure that a second person (trained as entry attendant) is available, and assists in the set up procedures.

Agree upon a means of communication between the entrant and the attendant. (The attendant is not authorized to perform rescue involving entry into the space, unless he/she is trained for rescue and another entry attendant replaces him/her prior to the attempt to rescue).

Attendant must have a means to contact emergency rescue services for further assistance.

Complete Confined Space Entry Permit:

1. Have the attendant verify the completion of the required actions;
2. Entry supervisor shall sign the Permit upon verification of completed actions;
3. Maintain the Permit at all authorized entry sites until completion of the entry;

5.2 PRCS Entry Permits

A PRCS Entry Permit is required to be completed for each individual PRCS entry operation (Exception: Multiple entries of an *individual PRCS* during a single work shift can be covered by a single Permit). The Permit provides the means for documenting:

- The identities and roles of all individuals involved in the entry operation.
- Equipment used for performance of the entry (monitoring instruments, extraction equipment, etc.).
- Pre-entry and operational monitoring results.
- Other relevant workplace conditions or events related to the entry operation (e.g., vault isolation procedures).

The Permit also provides the documented basis for re-classification of any PRCS as non-permit required (for purposes of the particular entry operation) based upon pre-entry monitoring procedures. Each Permit will be signed and authorized by the Entry Supervisor. At the completion of the entry operation, the Permit will be filed as part of the project records.

A copy of Geosyntec's PRCS Entry Permit form is provided in **Attachment 3** and an example of Geosyntec's Confined Space Entry Classification Guidance is provided in **Attachment 4**.

5.3 PRCS Entry Procedure

- Don any required PPE.
- Check the area around the seal to ensure that no flammable situations exist prior to door or cover removal. Note: ***Always check for oxygen levels first if the meter does not measure simultaneously. Low oxygen levels can cause LEL readings to be incorrect.***
- Carefully remove any access doors or covers.
- Upon removal of the access cover/door, check the immediate atmosphere using remote testing procedures to ensure the immediate atmosphere is safe. If any of the parameters being tested are outside the action level, do not enter.
- If necessary, use exhaust ventilation to either remove the contaminant(s) or to correct the oxygen-deficient atmosphere.
- If the initial test(s) are within allowable ranges, slowly enter the space, continually testing the atmosphere in front and to the sides.
- In stratified atmospheres (i.e., vertical entries), testing will be done 4 feet in advance of the direction of travel. Travel speed will allow for adequate instrument response time.
- The entire area where work is to be performed will be tested prior to performance of any work.

- While performing the work, place the direct read instruments in a location that will not interfere with the work, allow for continual monitoring, and allow for noting any alarms that may be activated.

- Upon work completion, pick up all equipment and leave the space.

5.4 PRCS Exit Procedure

- Replace all access covers.

- Ensure all signs are visible and legible.

- Remove all lockout/tagout equipment.

- Note on the Permit any problems encountered while in the space.

- Finish the Permit and turn it in to the Entrant Supervisor.

- The Entrant Supervisor will inspect the Permit for completion and investigate any noted problems. Actions taken to correct noted problems will be discussed with all authorized entrants and attendants for future implementation.

- The completed Permit will be maintained on file as required in this section.

6.0 NON-PERMIT REQUIRED CONFINED SPACE ENTRY PROCEDURE

DEFINITION: ***NON – PERMIT CONFINED SPACE*** (***NPCS***) is a confined space that:

1. Does not contain any hazard capable of causing death or serious physical harm.
2. With respect to atmospheric hazards, does not have the potential to contain any hazard capable of causing death or serious physical harm.

Persons entering this type of space only need to complete a confined space entry permit and remain vigilant about conditions in the space and remember that if any condition changes or if hazards are introduced into the space (e.g. welding/cutting operations), the classification and entry procedures in the space may change.

6.1 NPCS Entry Procedure

1. Check the atmosphere with the gas detector for Oxygen, LEL and other Hazardous gases (e.g. CH_4, H_2S, and CO) in the same order prior to entry into the space.

2. Record the measured conditions on the permit and do not allow entry if detected levels are above action levels.

3. When entrance covers are removed, guard the opening to prevent an accidental fall through the opening and to protect each employee working in the space from foreign objects entering the space.

4. Proceed with entry and work with caution.

6.2 NPCS Post-Entry Procedures

The following post-entry procedures must be followed after the completion of a non-permit required confined space entry:

1. Replace all access covers.

2. Ensure all signs are visible and legible.

3. Remove all lockout/tagout equipment, if applicable.

4. Note any problems encountered while in the space on the Permit.

5. Finish the permit, and turn in to the entrant supervisor.

6. The entrant supervisor shall inspect the Permit for completion, and investigate any noted problems. Actions taken to correct noted problems shall be discussed with all authorized entrants and attendants for future implementation.

7. The completed Permit shall be maintained in record for annual review.

7.0 MULTI-EMPLOYER ENTRY RESPONSIBILITIES

Geosyntec's Requirements- When using a subcontractor to perform work involving confined spaces, Geosyntec personnel must:

1. Inform the subcontractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of CFR 1910.146.
2. Appraise the subcontractor of the elements, including the hazards identified and all past experiences with the space, that make the space in question a permit space.
3. Appraise the subcontractor of any precautions or procedures that have been implemented for the protection of employees in or near permit spaces where Contractor personnel will be working.
4. Coordinate entry operations with the subcontractor, when both Geosyntec employees and subcontractor employees will be working in or near permit spaces so that Geosyntec employees and the subcontractor do not endanger each other; and
5. Debrief the subcontractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

Subcontractor Requirements - In addition to complying with the permit space requirements that apply to all employers, each subcontractor who is retained to perform permit space entry operations must:

1. Obtain any available information regarding permit space hazards and entry operations from the Geosyntec Project Manager;
2. Coordinate entry operations with the Project Manager when both Geosyntec personnel and subcontractor personnel will be jointly working in or near permit spaces; and
3. Inform Project Manager of the permit space program that the contractor will be using and of any hazards confronted or created in permit spaces, either through debriefing or during entry operations.

8.0 CONFINED SPACE ENTRY TRAINING

Personnel participating in the entry of any confined space must first complete initial confined space entry training equivalent to their assigned duties. In addition, personnel will receive site-specific training covering confined space entry procedures associated with the work site.

8.1 Initial Training

Personnel will not be permitted to perform entry of <u>any</u> confined space prior to completing this training. The training will be administered or approved by the H&S Department, and will consist of the following elements:

- Orientation regarding the differences between a confined space and a permit-required confined space (PRCS).
- Review of applicable regulatory requirements (29 CFR 1910.146).
- Review of this procedure.
- Air monitoring instrumentation calibration and monitoring methods.
- Use of respiratory protection and PPE during PRCS operations.
- Entrant duties during NPRCS and PRCS entries.
- Attendant duties during PRCS entries:

  Includes the entire above plus:

  - Emergency notification requirements.
  - Emergency response procedures.
  - Maintaining the list of Authorized Entrants.
  - Applicable state requirements for Attendants.
- Entry Supervisor duties during PRCS entries:

  Includes the entire above plus:

  - Accident and problem investigation techniques
  - Recordkeeping requirements

Initial training is intended only to qualify personnel to perform the duties of general confined space entry. This training must be supplemented by site/procedure-specific training prior to any new entry operation.

Refresher training is required any time there is a change in the overall program or procedures or when, based on observation or incident, a substantial non-compliance with this procedure is noted.

8.2 Site/Procedure-Specific Training

Because entry procedures will be specifically developed for individual PRCSs, personnel will require training in the specific procedure(s) prior to on site implementation. Training must be conducted by an authorized supervisor, member of the H&S Department, or an approved alternate and must be documented.

8.3 Annual Program Review

At least annually, (or whenever any incident or serious near miss occurs due to confined space entry an independent authorized employee who is not involved in the procedure being inspected must conduct and document a review and inspection of the confined space entry program specific to the

identified facility. The inspection should include a meeting with authorized employees and any other affected employees.

The inspection procedure must include the following elements.

- Discuss the entry supervisors, entry attendant, entrant, and rescuers (where applicable) responsibilities under the confined space entry program.
- Where confined space permit is used, discuss the entry attendant and entrant employee's responsibilities under the confined space entry program and the limitations of the program.
- If deficiencies are noted during the inspection, corrective actions and retraining of employees, as necessary, must be performed immediately.
- Review of all confined space permits filed during last 12 months. Review should be focused on any deficiencies recorded on the permit, with appropriate root-cause analysis and preventive and corrective actions.
- The inspector shall provide a copy of all inspection documentation to the applicable Geosyntec Project Manager for review and filing.

These inspections shall provide for a demonstration of the procedures and may be implemented through random audits and planned visual observations. These inspections are intended to ensure that the confined space program is being properly and consistently implemented.

9.0 RECORDKEEPING

- Inventories of confined spaces will be maintained until one year past project completion.
- Cancelled and completed Confined Space Entry Permits will be maintained for a minimum of one year.
- Any airborne measurements that represent employee exposure will be maintained in Geosyntec Employee Exposure files.
- All Entry Permits will be reviewed annually by a trained entry supervisor to determine if procedures are being followed and are adequate to protect employees. If necessary, the entry procedures will be modified to ensure personnel are protected when entering locations.

10.0 ATTACHMENTS

Attachment 1 – Facility-Specific Confined Space Identification Log

Attachment 2 – Confined Space Hazard Assessment Form

Attachment 3 – Geosyntec PRCS Space Entry Permit Form

Attachment 4 – Confined Space Entry Classification Guidance

ATTACHMENT 1
FACILITY-SPECIFIC
CONFINED SPACE IDENTIFICATION LOG

Name of Space and Location	Permit Required Confined Space				Non-Permit Required Confined Space	
	Y	Initial Date Inventoried			Y	Date Reclassified

ATTACHMENT 2
Confined Space Hazard Assessment Form

PART 1. CONFINED SPACE IDENTIFICATION
Confined Space Name:
Dimensions:
Description of Space:
Is this space entered on a routine basis? ☐Yes ☐ No
Described Tasks and Frequency:

PART II. NATURE OF THE HAZARDS – ASSUMPTIONS: Tanks are empty and clean, all energy sources identified and isolated, and no other hazards are introduced into the spaces. A more formal hazard assessment must be done at time of entry.

Potential Atmospheric Hazards	**Potential Non-Atmospheric Hazards**
☐ O_2 Deficient /Enriched	☐ Contains Material Which Could Engulf Entrant?_____
☐ Combustibles/Flammables	☐ Internal Config. Could Trap Entrant?_____
☐ CO	☐ Electrical (live circuits)? _____
☐ H_2S	☐ Mechanical (pipes, linkages)?_____
☐ Other Toxics	☐ Slick/Residue Covered Surfaces?_____
	☐ Equipment Preventing Safe Exit?_____
	☐ Low/Inadequate Lighting?_____
	☐ Hazardous Chemicals Present? _____
	☐ Fall Potential?_____
	☐ Potential for Dropped Objects?_____
	☐ Multiple Work Groups/Nature of Work_____
	☐ Other _____

Photo of Space Here...

Attachment 3: Geosyntec PRCS Entry Permit Form

1. Permit space to be entered:_____ Project Name & No.:_____
2. Purpose of entry:_____
3. Good on this date only:_____ From:_____AM/PM To:_____ AM/PM

Authorized Entrants:	Authorized Attendants:	Entry Supervisor:
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Hazards within the permit space:_____
_____
_____

5. Permit Space Preparation

1.	Work area isolated with signs/barriers?	_____Yes	_____No
2.	All energy sources locked/tagged out?	_____Yes	_____No
3.	All input lines capped/blinded?	_____Yes	_____No
4.	Permit Space contents drained/flushed/neutralized?	_____Yes	_____No
5.	Permit Space cleaned/purged?	_____Yes	_____No
6.	Ventilation provided 30 minutes before entry?	_____Yes	_____No

6. Initial atmospheric testing.

	Reading	Time	Acceptable level
Oxygen%	_____	_____	_____
LEL	_____	_____	_____
Other Contaminants	_____	_____	_____
Other Contaminants	_____	_____	_____
Other Contaminants	_____	_____	_____

7.

Test (s) To Be Taken	Permissible Entry Levels	Test 1	Test 2	Test 3	Test 4
A. Percent of Oxygen	19.5% to 23.5%				
B. Explosivity	<10% LEL				
C. Carbon Monoxide	< 25ppm				
D. Hydrogen Sulfide	< 5 ppm				
E. MISC.					
Name of Tester					
Test Times					

8. Rescue Services (circle one) On Site Off Site

Phone # for Rescue Services or means of summoning:
_____
_____

9. Communication devices and procedures to be used during entry:
_____
_____

10. Safety Equipment required for entry:

PPE	N/A ( )	YES ( )	Specify_____
Testing Equipment	N/A ( )	YES ( )	Specify_____
Alarm System	N/A ( )	YES ( )	Specify_____
Rescue Equipment	N/A ( )	YES ( )	Specify_____
Other	N/A ( )	YES ( )	Specify_____

11. Additional Permits Required:
Hot work: _____ Yes _____ No
Other: _____ Yes _____ No

12. Permit Authorization
I certify that I have inspected the work area for safety and reviewed all safety precautions recorded on this permit.

Permit Authorization by entry Supervisor (Signature): _____Date/Time_____

13. Permit Conditions Verification:

Physical conditions at confined space checked and verified to be in accordance with the permit Yes No
If no; please record the deviation observed and corrective action taken:

_____

_____

Verified by : _____ _____ _____
(Entry Supervisor) Date Time

14. Review & Close-out:
Please list problems encountered during entry:

_____

_____

Corrective / Preventive Action Taken:

_____

_____

Additional Precautions / Recommendation for Future Entry:

_____

_____

Based on this review, this confined space shall be considered:
- Permit Required Confined Space Yes No
- Non-Permit Required Confined Space Yes No

Reviewed By: _____ _____ _____
(Entry Supervisor) Date Time

Attachment 4

Confined Space Entry Classification Guidance											
Facility Name Here											
						METER READINGS					
Confined Space Name	Confined Space Location	Task Description	Permit required confined space		Enter Following Non Permit Procedure	O2	LEL	H2S	CO	Entry rescue	Non entry rescue

US Health & Safety Procedures

Asbestos

1.0 PURPOSE

The requirements below apply for all Geosyntec activities where asbestos-containing materials (ACM) may be encountered as an ancillary part of environmental practice activities. These procedures meet the requirements of 29 CFR 1910.1001 and 29 CFR 1926.1101. This procedure applies to all of the subsidiaries, affiliates, and operating units of the Geosyntec family of companies in the US (hereinafter referred to as "Geosyntec" or the "Company"). Any exceptions to this procedure must be approved, in writing, by the Health and Safety (H&S) Director.

2.0 APPLICABLE DEFINITIONS

Asbestos – means any member of a group of fibrous mineral types found naturally occurring in many parts of the world. Most common in the United States is chrysotile, a white-colored mineral widely used in fire-retardant product and thermal insulation. Other asbestos forms include amosite (a brownish mineral), cricidolite (a bluish mineral), tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.

Asbestos Containing Material (ACM) – means bulk materials containing, or presumed to contain, asbestos in excess of 1.0% by mass.

Class I Asbestos Work – removal of thermal system insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II Asbestos Work – removal of ACM which is not TSI or surfacing material; this includes floor tile, roofing products, construction mastics, etc.

HAZWOPER – means any onsite contamination investigation or clean-up activities subject to the operational requirements of 29 CFR 1910.120.

Acceptable Exposure Limit (AEL) – Means the maximum exposure concentration to which a Geosyntec employee can be subjected, normalized to an 8 (eight) hour time weighted average (TWA) and with consideration of the mitigation provided by any respiratory protection which may be used. For normal work shifts (8-hours or less) Geosynec's asbestos AEL is 0.1 fibers per cubic centimeter of air (0.1 f/cc).

3.0 RESPONSIBILITIES

3.1 H&S Department

- Provide technical assistance in the identification of ACM and the evaluation of asbestos exposure hazards as requested by management personnel.
- Review and approve all asbestos exposure hazard assessments prior to the start of work activities.

- Review and approve all asbestos abatement plans and exposure monitoring activities to ensure compliance with federal, state and local regulations.

3.2 Project Managers

- Assure that the presence of ACM at Geosyntec work sites is identified (where reasonably possible) prior to commencing field activities, that prior to initiating any task involving disturbance of or contact with ACM (or immediately upon identification of previously unknown ACM) a task asbestos exposure hazard assessment is developed and approved by the H&S Department, and that the applicable requirements of Section 3.0 are observed for each task where the asbestos exposure assessment indicates that the airborne asbestos fiber concentrations can exceed the AEL.
- Assure that employees developing work procedures and/or conducting work activities involving ACM possess any required state specific registrations or certifications.
- Assure that employee's assigned to perform any work activities involving ACM have been trained in the job-specific hazards of asbestos exposure, have received proper medical surveillance, and are trained and properly fit tested in the use of any designated respiratory protection devices.

3.3 All Geosyntec Employees

- Do not disturb or handle any ACM or suspected ACM without appropriate personal protective equipment (PPE), training in the job-specific hazards of asbestos exposure, medical monitoring, and respirator fit test.
- Immediately notify the Project Manager of the presence or suspected presence of previously unidentified ACM in the workplace, and cease all work activities involving disturbance or contact with the materials until further direction is received.

4.0 OPERATIONAL REQUIREMENTS

The following operation-specific requirements pertain to activities where the presence of ACM is identified, suspected or is recognized as a significant operational occurrence.

4.1 HAZWOPER Activities

Asbestos may be present at HAZWOPER sites as a soil contaminant or building material. If such contamination is noted, the following requirements must be observed:

- The site-specific health and safety plan (HASP) and/or appropriate health and safety planning document must provide a specific analysis of the asbestos exposure hazard for each task involving the disturbance or handling of ACM.
- If any potential is identified for worker inhalation exposures to exceed the AEL then specific asbestos exposure control and monitoring procedures must be developed for the work activity and included in the HASP. Air sampling strategies will include personal sampling with a known volume of air drawn through a 25-mm diameter cassette containing a mixed-cellulose ester filter. The cassette will be equipped with an electrically conductive 50-mm extension cowl.
- If workers may be exposed in excess of the AEL, they must complete baseline medical monitoring and asbestos training as detailed below.

4.2 Class I or Class II Asbestos Work Activities

The past widespread use of ACM in buildings is widely recognized as the source of a significant exposure hazard for personnel performing building demolition/renovation activities. Accordingly, the following requirements will be observed:

- Prior to commencement of possible Class I or Class II activities, a thorough inspection and sampling program will be completed throughout the demolition area to identify the presence of ACM.
- Where feasible, ACM will be removed prior to commencement of general work activities.
- The hazards of the removal work will be addressed in an Asbestos Abatement Plan, which will provide exposure controls and monitoring procedures to prevent worker exposures in excess of the AEL. The Asbestos Abatement Plan must be approved by the H&S Department prior to implementation.
- A demolition or renovation notification must be filed with and approved by the EPA and any local construction regulatory agencies prior to commencing demolition activities.
- Workers will meet the training and medical monitoring requirements detailed below.

5.0 MEDICAL MONITORING AND TRAINING REQUIREMENTS

The following requirements pertain to all workers performing Class I or Class II asbestos work, or tasks where the associated asbestos exposure assessment indicates the potential to exceed the AEL.

5.1 Medical Monitoring Requirements

Personnel will complete an asbestos-protocol medical monitoring procedure meeting the requirements of H&S 108 US – Medical Monitoring and Surveillance. Workers must have a medical clearance from Geosyntec's Corporate Medical Provider to perform work involving potential asbestos exposures.

Medical exams shall be conducted:

- Prior to assignment to an area requiring negative pressure respirators.
- Prior to assignment to an area where the action level may be exceeded.
- On an annual basis for personnel performing on-going asbestos work or more frequently if the examining physician deems it advisable for medical reasons.
- Within 30 days before or after the date of termination of employment for any employee who has been exposed at or above the AL.

The medical exam shall include:

- A medical and work history.
- A complete physical exam with emphasis on the respiratory system, cardiovascular system and respiratory tract.
- Completion of the standardized medical history questionnaire found in Appendix D of 29 CFR 1910.1001.
- Pulmonary function test.
- Chest X-ray for the initial exam, and periodically thereafter as deemed necessary by the physician or according to the following chart.

Years Since Employee First Exposed	Age of Employee		
	15 - 35	**35 - 45**	**45 plus**
0 - 10	every 5 years	every 5 years	every 5 years
10 plus	every 5 years	every 2 years	every year

5.2 Training

Training will be provided prior to or at the time of initial assignment, and at least annually thereafter. Training will be provided at no cost to the employee.

For Class I activities workers must be accredited as asbestos abatement workers under the EPA Model Accreditation Plan.

For Class II activities which involve asbestos-containing roofing materials, flooring materials, siding materials, ceiling tiles, or transite panels workers must be trained in the topics outlined by OSHA, including hands-on, for a minimum of 8 hours. For Other Class II activities workers must be trained in the OSHA-required topics, including hands-on training, and cover the OSHA work practices and engineering control requirements detailed for Class II work.

HAZWOPER work activities involving potential contact and/or exposure to airborne asbestos fibers in construction debris, landfill constituents, etc. must be performed by HAZWOPER-qualified personnel who receive an additional 2-hours of asbestos awareness training which addresses:

- Hazards of asbestos.
- Asbestos exposure limits and other regulatory requirements.
- Asbestos exposure prevention measures.

This training will be provided by the H&S Department on an as-needed basis.

5.3 Respiratory Protection

Where respiratory protection is specified for use in controlling worker exposures to asbestos, each employee must:

- Be medically qualified for use of the specified respiratory protection.
- Complete respirator training and fit testing.
- Be assigned an appropriate respirator for use during field operations.

Full-face air purifying respirators equipped with P100 particulate matter cartridges are appropriate for most work activities involving asbestos. The use of supplied air respiratory protection requires the prior approval of the H&S Department.

6.0 REFERENCES

- HS 108 US – Medical Monitoring and Surveillance

Appendix G: Safety Data Sheets

Included in this HASP	Chemical
☐	Acetone
☒	Alconox
☐	Ammonia
☐	Bentonite
☒	Diesel Fuel Oil No. 2-D
☒	Gasoline
☐	Helium
☐	Hexane
☐	Hydrochloric Acid
☐	Hydrogen
☐	Isobutylene Calibration Gas
☐	Isopropyl Alcohol
☐	KB-1
☐	Methane Calibration Gas
☐	Nitric Acid
☐	Permanganate
☐	Portland Cement
☐	Sulfuric Acid
☐	Other: _____
☐	Other: _____
☐	Other: _____
☐	Other: _____

Note: SDSs are for chemicals that used to perform project work, not site contaminants.

SAFETY DATA SHEET

SDS ID NO.: 0290MAR019
Revision Date 06/01/2016

1. IDENTIFICATION

Product Name: Marathon Petroleum No. 2 Ultra Low Sulfur Diesel

Synonym: #2 Diesel; No. 2 Ultra Low Sulfur Diesel 15 ppm Sulfur Max; Ultra Low Sulfur Diesel No. 2 15 ppm Sulfur Max; Ultra Low Sulfur Diesel No. 2 15 ppm Sulfur Max with Polar Plus; No. 2 Diesel, Motor Vehicle Use, Undyed; No. 2 Diesel, Motor Vehicle Use, Undyed, with Polar Plus; ULSD No. 2 Diesel 15 ppm Sulfur Max; ULSD No. 2 Diesel 15 ppm Sulfur Max with Polar Plus; No. 2 MV 15 Diesel; No. 2 MV 15 Diesel with Polar Plus; No. 2 Ultra Low Sulfur Diesel Dyed 15 ppm Sulfur Max; Ultra Low Sulfur Diesel No. 2 Dyed 15 ppm Sulfur Max; Ultra Low Sulfur Diesel No. 2 Dyed 15 ppm Sulfur Max with Polar Plus; No. 2 Diesel, Tax Exempt-Motor Vehicle Use, Dyed; No. 2 Diesel, Tax Exempt-Motor Vehicle Use, Dyed, with Polar Plus; ULSD No. 2 Diesel Dyed 15 ppm Sulfur Max; ULSD No. 2 Diesel Dyed 15 ppm Sulfur Max, with Polar Plus; No. 2 MV 15 Diesel Dyed; #2 MV 15 CFI Diesel; #2 MV 15 CFI Diesel Dyed; No. 2 Low Sulfur Diesel (TxLED); No. 2 MV 15 Diesel Dyed, with Polar Plus; No. 2 NRLM 15 Diesel Dyed; No.2 NRLM Diesel Dyed; No. 2 MV 500 ppm TxLED; No.2 Low Emission Low Sulfur Diesel; No. 2 Low Sulfur Diesel (TxLED) 500 ppm Sulfur Max; No. 2 Heating Oil 5000 NMA Unmarked; NEMA No. 2 Heating Oil; Heating Oil, No. 2 Low Sulfur 5000 ppm; No. 2 Ultra Low Sulfur Diesel Dyed with <6% Renewable Diesel Fuel; Ultra Low Sulfur No. 2 Diesel Dyed with <6% Renewable Diesel Fuel; No. 2 Diesel Dyed with <6% Renewable Diesel Fuel 15 ppm Sulfur Max; No. 2 Ultra Low Sulfur Diesel with <6% Renewable Diesel Fuel; Ultra Low Sulfur No. 2 Diesel with <6% Renewable Diesel Fuel; No. 2 Diesel with <6% Renewable Diesel Fuel 15 ppm Sulfur Max; Garyville Export Diesel; Export Diesel, Garyville; Diesel Fuel, Export Garyville; #2 Motor Vehicle ULSD 15 ppm with 0-5% Renewable Diesel; Marathon No. 2 ULSD with 0-5% Renewable Fuel with R100; Marathon No. 2 ULSD with 0-5% Renewable Fuel with R99; No. 2 Heating Oil 2000 ppm Sulfur Max, Clear (Undyed) Unmarked;Ultra Low Sulfur Heating Oil 15 ppm Sulfur Max, Clear (Undyed) Unmarked; ULS Heating Oil 15 ppm Clear (Undyed) Unmarked; ULS HO 15 ppm CLR; Ultra-Low Sulfur Heating Oil (<= 15ppm, Undyed); No. 2 Heating Oil 2000 ppm Sulfur Max, Dyed Unmarked; No. 2 Heating Oil 2000 ppm Sulfur Max, Dyed Marked; Ultra Low Sulfur Heating Oil 15 ppm Sulfur Max, Dyed Unmarked; Ultra Low Sulfur Heating Oil 15 ppm Sulfur Max, Dyed Marked;15 ppm Sulfur Heating Oil Grade 67; 15 PPM Heating Oil; 15 PPM Dyed Heating Oil; 0291MAR019; 0306MAR019; 0308MAR019; 0334MAR019; 0335MAR019; 0336MAR019; 0337MAR019; 0340MAR019;

Product Code: 0290MAR019
Chemical Family: Complex Hydrocarbon Substance

Recommended Use: Fuel.
Restrictions on Use: All others.

Manufacturer, Importer, or Responsible Party Name and Address:

MARATHON CANADA MARKETING, Ltd.
Canadian Address Here

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 3
Acute toxicity - Inhalation (Dusts/Mists)	Category 4
Skin corrosion/irritation	Category 2
Carcinogenicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 2
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Harmful if inhaled
Causes skin irritation
May cause respiratory irritation
May cause drowsiness or dizziness
Suspected of causing cancer
May cause damage to organs (thymus, liver, bone marrow) through prolonged or repeated exposure
Toxic to aquatic life with long lasting effects

Appearance Yellow to Red Liquid **Physical State** Liquid **Odor** Hydrocarbon

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use only non-sparking tools.
Use explosion-proof electrical/ventilating/lighting/equipment
Take precautionary measures against static discharge
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection

Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor if you feel unwell
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

No. 2 Ultra Low Sulfur Diesel is a complex mixture of paraffins, cycloparaffins, olefins and aromatic hydrocarbon chain lengths predominantly in the range of eleven to twenty carbons. May contain up to 5% Renewable Diesel. May contain small amounts of dye and other additives (<0.15%) which are not considered hazardous at the concentration(s) used. May contain a trace amount of benzene (<0.01%). Contains a trace amount of sulfur (<0.0015%)

Composition Information:

Name	CAS Number	% Concentration
No. 2 Diesel Fuel	68476-34-6	50-100
Kerosine (petroleum)	8008-20-6	0-50
Alkanes, C10-C20 branched and linear	928771-01-1	0-5
Naphthalene	91-20-3	0.3-2.6

All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First Aid Measures

General Advice: In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Skin Contact: Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking. Prolonged or repeated exposure may cause adverse effects to the thymus, liver, and bone marrow.

Indication of any immediate medical attention and special treatment needed

Notes To Physician: INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be a flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 128.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.

Sensitivity to Static Discharge Yes.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Avoid excessive water spray application. Keep surrounding area cool with water spray from a distance and prevent further ignition of combustible material. Keep run-off water out of sewers and water sources.

Additional firefighting tactics
FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

NFPA	Health 1	Flammability 2	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources. All contaminated surfaces will be slippery.

Protective equipment: Use personal protection measures as recommended in Section 8.

Emergency procedures: Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions: Avoid release to the environment. Avoid subsoil penetration.

Methods and materials for containment: Contain liquid with sand or soil. Prevent spilled material from entering storm drains, sewers, and open waterways.

Methods and materials for cleaning up: Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions: NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Vapors may travel along the ground or be moved by ventilation. Flashback may occur along vapor trails. No smoking. Use only non-sparking tools. Avoid breathing fumes, gas, or vapors. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists

from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Do not store near an open flame, heat or other sources of ignition.

Incompatible Materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
No. 2 Diesel Fuel 68476-34-6	100 mg/m^3 TWA Skin - potential significant contribution to overall exposure by the cutaneous route	-	-	-
Kerosine (petroleum) 8008-20-6	200 mg/m^3 TWA Skin - potential significant contribution to overall exposure by the cutaneous route	-	-	-
Alkanes, C10-C20 branched and linear 928771-01-1	-	-	-	-
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm TWA: 50 mg/m^3	10 ppm TWA 50 mg/m^3 TWA 15 ppm STEL 75 mg/m^3 STEL	250 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or with inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection:	Use goggles or face-shield if the potential for splashing exists.
Skin and body protection:	Wear neoprene, nitrile or PVA gloves to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.
Respiratory protection:	Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when there is the potential for airborne exposures to exceed permissible exposure limits or if excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.
Hygiene measures:	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Yellow to Red Liquid
Color	Yellow to Red
Odor	Hydrocarbon
Odor Threshold	No data available.

Property	**Values (Method)**
Melting Point / Freezing Point	No data available.
Initial Boiling Point / Boiling Range	154-366 °C / 310-691 °F (ASTM D86)
Flash Point	58-76 °C / 136-168 °F (ASTM D93)
Evaporation Rate	No data available.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%):	
Upper Flammability Limit:	No data available.
Lower Flammability Limit:	No data available.
Explosion limits:	No data available.
Vapor Pressure	No data available.
Vapor Density	No data available.
Specific Gravity / Relative Density	0.82-0.86
Water Solubility	No data available.
Solubility in other solvents	No data available.
Partition Coefficient	No data available.
Decomposition temperature	No data available.
pH:	Not applicable
Autoignition Temperature	No data available.
Kinematic Viscosity	1.90-3.32 cSt @ 40°C (ASTM D445)
Dynamic Viscosity	No data available.
Explosive Properties	No data available.
VOC Content (%)	No data available.
Density	No data available.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity	The product is non-reactive under normal conditions.
Chemical stability	The material is stable at 70°F (21°C), 760 mmHg pressure.
Possibility of hazardous reactions	None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Excessive heat, sources of ignition, open flame.

Incompatible Materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation Harmful if inhaled. May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.

Eye contact Exposure to vapor or contact with liquid may cause mild eye irritation, including tearing, stinging, and redness.

Skin contact Irritating to skin. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
No. 2 Diesel Fuel 68476-34-6	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	>1 - <5 mg/L (Rat) 4 h
Kerosine (petroleum) 8008-20-6	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.28 mg/L (Rat) 4 h
Alkanes, C10-C20 branched and linear 928771-01-1	-	-	>1 - <5 mg/l (Rat) 4 h
Naphthalene 91-20-3	490 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 340 mg/m^3 (Rat) 1 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

MIDDLE DISTILLATES, PETROLEUM: Long-term repeated (lifetime) skin exposure to similar materials has been reported to result in an increase in skin tumors in laboratory rodents. The relevance of these findings to humans is not clear at this time. Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage (so-called Petrol Sniffer's Encephalopathy), delirium, seizures, and sudden death have been reported from repeated overexposure to some hydrocarbon solvents, naphthas, and gasoline.

MIDDLE DISTILLATES WITH CRACKED STOCKS: Light cracked distillates have been shown to be carcinogenic in animal tests and have tested positive with in vitro genotoxicity tests. Repeated dermal exposures to high concentrations in test animals resulted in reduced litter size and litter weight, and increased fetal resorptions at maternally toxic doses. Dermal exposure to high concentrations resulted in severe skin irritation with weight loss and some mortality. Inhalation exposure to high concentrations resulted in respiratory tract irritation, lung changes/infiltration/accumulation, and reduction in lung function.

ISOPARAFFINS: Studies in laboratory animals have shown that long-term exposure to similar materials (isoparaffins) can cause kidney damage and kidney cancer in male laboratory rats. However, in-depth research indicates that these findings are unique to the male rat, and that these effects are not relevant to humans.

NAPHTHALENE: Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from overexposure to naphthalene. Persons with glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have been reported in persons overexposed to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect. Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) in vitro. Naphthalene has been classified as Possibly Carcinogenic to Humans (2B) by IARC, based on findings from studies in laboratory animals.

DIESEL EXHAUST: The combustion of diesel fuels produces gases including carbon monoxide, carbon dioxide, oxides of nitrogen and/or sulfur, and hydrocarbons that can be irritating and hazardous with overexposure. Long-term occupational overexposure to diesel exhaust and diesel exhaust particulate matter has been associated with an increased risk of respiratory disease, including lung cancer, and is characterized as a “known human carcinogen” by the International Agency for Research on Cancer (IARC), as “a reasonably anticipated human carcinogen” by the National Toxicology Program, and as “likely to be carcinogenic to humans” by the EPA, based upon animal and occupational exposure studies. However, uncertainty exists with these classifications because of deficiencies in the supporting occupational exposure/epidemiology studies, including reliable exposure estimates. Lifetime animal inhalation studies with pulmonary overloading exposure concentrations of diesel exhaust emissions have produced tumors and other adverse health effects. However, in more recent long-term animal inhalation studies of diesel exhaust emissions, no increase in tumor incidence and in fact a substantial reduction in adverse health effects along with significant reductions in the levels of hazardous material emissions were observed and are associated with fuel composition alterations coupled with new technology diesel engines.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and Symptoms Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking. Prolonged or repeated exposure may cause damage to organs.

Skin corrosion/irritation Causes skin irritation.
Serious eye damage/eye irritation None known.
Sensitization None known.

Mutagenic effects None known.

Carcinogenicity Suspected of causing cancer.

Cancer designations are listed in the table below

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
No. 2 Diesel Fuel 68476-34-6	Confirmed animal carcinogen (A3)	Not Classifiable (3)	Not Listed	Not Listed
Kerosine (petroleum) 8008-20-6	Confirmed animal carcinogen (A3)	Not Classifiable (3)	Not Listed	Not Listed
Alkanes, C10-C20 branched and linear 928771-01-1	Not Listed	Not Listed	Not Listed	Not Listed

Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

Reproductive toxicity None known.

Specific Target Organ Toxicity (STOT) - single exposure Respiratory system. Central nervous system.

Specific Target Organ Toxicity (STOT) - repeated exposure Thymus. Liver. Bone marrow.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
No. 2 Diesel Fuel 68476-34-6	-	96-hr LC50 = 35 mg/l Fathead minnow (flow-through)	-	48-hr EL50 = 6.4 mg/l Daphnia magna
Kerosine (petroleum) 8008-20-6	72-hr EL50 = 5.0-11 mg/l Algae	96-hr LL50 = 18-25 mg/l Fish	-	48-hr EL50 = 1.4-21 mg/l Invertebrates
Alkanes, C10-C20 branched and linear 928771-01-1	-	-	-	-
Naphthalene 91-20-3	-	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	-	48-hr LC50 = 1.6 mg/l Daphnia magna

Persistence and degradability Expected to be inherently biodegradable.

Bioaccumulation Has the potential to bioaccumulate.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper Shipping Name:	Fuel Oil, No. 2
UN/Identification No:	NA 1993
Class:	3
Packing Group:	III

TDG (Canada):

UN Proper Shipping Name:	Diesel Fuel
UN/Identification No:	UN 1202
Transport Hazard Class(es):	3
Packing Group:	III

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
No. 2 Diesel Fuel	NA
Kerosine (petroleum)	NA
Alkanes, C10-C20 branched and linear	NA
Naphthalene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
No. 2 Diesel Fuel	NA
Kerosine (petroleum)	NA
Alkanes, C10-C20 branched and linear	NA
Naphthalene	100 lb final RQ 45.4 kg final RQ

SARA Section 311/312: The following EPA hazard categories apply to this product:

Acute Health Hazard
Fire Hazard
Chronic Health Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
No. 2 Diesel Fuel	None
Kerosine (petroleum)	None
Alkanes, C10-C20 branched and linear	None
Naphthalene	0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

No. 2 Diesel Fuel

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 2444
Pennsylvania Right-To-Know:	Not Listed
Massachusetts Right-To Know:	Not Listed
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	SN 2444 TPQ: 10000 lb (Under N.J.A.C. 7:1G, environmental hazardous substances in mixtures such as gasoline or new and used petroleum oil may be reported under these categories)
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Kerosine (petroleum)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1091
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	SN 1091 TPQ: 10000 lb (Under N.J.A.C. 7:1G, environmental hazardous substances in mixtures such as gasoline or new and used petroleum oil may be reported under these categories)
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Alkanes, C10-C20 branched and linear

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed
Pennsylvania Right-To-Know:	Not Listed
Massachusetts Right-To Know:	Not Listed
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Naphthalene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/19/02

New Jersey Right-To-Know:	SN 1322 SN 3758
Pennsylvania Right-To-Know:	Environmental hazard Present (particulate)
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen
New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ: 500 lb (Reportable at the de minimis quantity of >0.1%)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	100 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all of the information required by those regulations.

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
No. 2 Diesel Fuel	B3,D2A,D2B	0.1%
Kerosine (petroleum)	B3,D2B	1%
Alkanes, C10-C20 branched and linear	B3,D2A,D2B	0.1%
Naphthalene	B4,D2A	0.1%

Note: Not applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety

Issue Date 10/31/2016

Revision Notes

Revision Date 06/01/2016

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS ID NO.: 0127MAR019
Revision Date 06/01/2016

1. IDENTIFICATION

Product Name: Marathon Petroleum Gasoline - All Grades

Synonym: Gasoline; Regular Unleaded Gasoline; Conventional Regular Unleaded Gasoline; Mid Grade Unleaded Gasoline; Conventional Mid Grade Unleaded Gasoline; Premium Unleaded Gasoline; Conventional Premium Unleaded Gasoline; Sub-Octane Gasoline; Regular RBOB; Super RBOB; Premium RBOB; RBOB; Reformulated Blend Stock For Oxygenated Blending; 84 Octane Gasoline; CBOB; Premium CBOB; Conventional Blend Stock for Oxygenate Blending; Recreational Gasoline; Recreational Gasoline; Recreational Unleaded Gasoline; 89 Recreational Gasoline; Brand 89 Recreational Gasoline; 7.0 Max RVP 89 Recreational Gasoline; BR 7.0 Max RVP 89 Recreational Gasoline; 90 Recreational Gasoline; 90 Marina Gasoline; Brand 91 Recreational Gasoline; 91 Recreational Gasoline; 91 Marina Gasoline; 90 Octane Midgrade Gasoline with No Ethanol; 0125MAR019; 0126MAR019; 0134MAR019; 0313MAR019; 0314MAR019

Product Code: 0127MAR019
Chemical Family: Complex Hydrocarbon Substance

Recommended Use: Fuel.
Restrictions on Use: All others.

Manufacturer, Importer, or Responsible Party Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 1
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1B
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

EXTREMELY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation
May cause respiratory irritation
May cause drowsiness or dizziness
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
Toxic to aquatic life with long lasting effects

Appearance Clear yellow liquid **Physical State** Liquid **Odor** Hydrocarbon

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take action to prevent static discharges
Avoid breathing mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor if you feel unwell
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Gasoline is a complex combination of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons having molecular chains ranging in length from four to ten carbons. May contain small amounts of dye and other additives (>0.02%) which are not considered hazardous at the concentrations used.

Composition Information:

Name	CAS Number	% Concentration
Gasoline	86290-81-5	100
Heptane (mixed isomers)	142-82-5	2.5-26
Butane (mixed isomers)	106-97-8	0.5-19
Pentane (mixed isomers)	78-78-4	6.5-19
Hexane Isomers (other than n-Hexane)	107-83-5	2-12
Toluene	108-88-3	3-9.5
Xylene (mixed isomers)	1330-20-7	3.5-9.5
n-Hexane	110-54-3	0.1-4.5
Cumene	98-82-8	0-4
1,2,4 Trimethylbenzene	95-63-6	1-4
Ethylbenzene	100-41-4	0.5-2.5
Benzene	71-43-2	0.1-1.5
Cyclohexane	110-82-7	0-1.5
Octane	111-65-9	0-1.5
1,2,3-Trimethylbenzene	526-73-8	0-1
Naphthalene	91-20-3	0.1-0.5

All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First Aid Measures

General Advice: In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. If symptoms occur get medical attention.

Skin Contact: Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected

person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Indication of any immediate medical attention and special treatment needed

Notes To Physician: INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be an extremely flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 128.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge Yes.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

Additional firefighting tactics
FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or

monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

NFPA	Health 1	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective equipment: Use personal protection measures as recommended in Section 8.

Emergency procedures: Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions: Avoid release to the environment. Avoid subsoil penetration. Ethanol in gasoline phase seperates in contact with water. Monitor downstream for dissolved ethanol or other appropriate indicators.

Methods and materials for containment: Contain liquid with sand or soil. Prevent spilled material from entering storm drains, sewers, and open waterways.

Methods and materials for cleaning up: Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions: NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Vapors may travel along the ground or be moved by ventilation. Flashback may occur along vapor trails. No smoking. Use only non-sparking tools. Avoid contact with skin, eyes and clothing. Avoid breathing fumes, gas, or vapors. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only

approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Do not store near an open flame, heat or other sources of ignition.

Incompatible Materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
Gasoline 86290-81-5	300 ppm TWA 500 ppm STEL	-	300 ppm TWA 900 mg/m³ TWA 500 ppm STEL 1500 mg/m³ STEL	-
Heptane (mixed isomers) 142-82-5	400 ppm TWA 500 ppm STEL	TWA: 500 ppm TWA: 2000 mg/m³	400 ppm TWA 1600 mg/m³ TWA 500 ppm STEL 2000 mg/m³ STEL	750 ppm
Butane (mixed isomers) 106-97-8	1000 ppm STEL	-	800 ppm TWA 1900 mg/m³ TWA	-
Pentane (mixed isomers) 78-78-4	1000 ppm TWA	-	-	-
Hexane Isomers (other than n-Hexane) 107-83-5	500 ppm TWA 1000 ppm STEL	-	500 ppm TWA 1800 mg/m³ TWA 1000 ppm STEL 3600 mg/m³ STEL	-
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	100 ppm TWA 375 mg/m³ TWA 150 ppm STEL 560 mg/m³ STEL	500 ppm
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m³	100 ppm TWA 435 mg/m³ TWA 150 ppm STEL 655 mg/m³ STEL	900 ppm
n-Hexane 110-54-3	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 500 ppm TWA: 1800 mg/m³	50 ppm TWA 180 mg/m³ TWA	1100 ppm
Cumene 98-82-8	50 ppm TWA	TWA: 50 ppm TWA: 245 mg/m³ Skin	50 ppm TWA 245 mg/m³ TWA Limit applies to skin	900 ppm
1,2,4 Trimethylbenzene	25 ppm TWA	-	25 ppm TWA	-

95-63-6			125 mg/m³ TWA	
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m³	100 ppm TWA 435 mg/m³ TWA 125 ppm STEL 545 mg/m³ STEL	800 ppm
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	25 ppm Ceiling 1 ppm TWA 5 ppm STEL	500 ppm
Cyclohexane 110-82-7	100 ppm TWA	TWA: 300 ppm TWA: 1050 mg/m³	300 ppm TWA 1050 mg/m³ TWA	1300 ppm
Octane 111-65-9	300 ppm TWA	TWA: 500 ppm TWA: 2350 mg/m³	300 ppm TWA 1450 mg/m³ TWA 375 ppm STEL 1800 mg/m³ STEL	1000 ppm
1,2,3-Trimethylbenzene 526-73-8	25 ppm TWA	-	25 ppm TWA 125 mg/m³ TWA	-
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm TWA: 50 mg/m³	10 ppm TWA 50 mg/m³ TWA 15 ppm STEL 75 mg/m³ STEL	250 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection: Use goggles or face-shield if the potential for splashing exists.

Skin and body protection: Use nitrile rubber, Viton® or PVA gloves for repeated or prolonged skin exposure. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection: Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when there is the potential for airborne exposures to exceed permissible exposure limits or if excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State Liquid
Appearance Clear yellow liquid
Color Yellow
Odor Hydrocarbon
Odor Threshold No data available.

Property	Values (Method)
Melting Point / Freezing Point	No data available.
Initial Boiling Point / Boiling Range	24-210 °C / 75-410 °F (ASTM D86)

Flash Point	-43 °C / -45 °F
Evaporation Rate	No data available.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.6
Lower Flammability Limit:	1.4
Explosion limits:	No data available.
Vapor Pressure	5.5-15 psi (ASTM D4814)
Vapor Density	3-4
Specific Gravity / Relative Density	0.70-0.76
Water Solubility	No data available.
Solubility in other solvents	No data available.
Partition Coefficient	2.13-4.5
Decomposition temperature	No data available.
pH:	Not applicable
Autoignition Temperature	280 °C / 536 °F
Kinematic Viscosity	No data available.
Dynamic Viscosity	No data available.
Explosive Properties	No data available.
VOC Content (%)	100%
Density	No data available.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F (21°C), 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Excessive heat, sources of ignition, open flame.

Incompatible Materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.

Eye contact Exposure to vapor or contact with liquid may cause mild eye irritation, including tearing, stinging, and redness.

Skin contact Irritating to skin. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Gasoline	14000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.2 mg/L (Rat) 4 h

86290-81-5			
Heptane (mixed isomers) 142-82-5	-	3000 mg/kg (Rabbit)	103 g/m³ (Rat) 4 h
Butane (mixed isomers) 106-97-8	-	-	658 mg/L (Rat) 4 h
Pentane (mixed isomers) 78-78-4	-	-	450 mg/L (Mouse) 2 h
Hexane Isomers (other than n-Hexane) 107-83-5	> 5000 mg/kg (Rat)	-	-
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
n-Hexane 110-54-3	15000 mg/kg (Rat)	3000 mg/kg (Rabbit)	48000 ppm (Rat) 4 h
Cumene 98-82-8	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h
1,2,4 Trimethylbenzene 95-63-6	3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	18,000 mg/m³ (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h
Cyclohexane 110-82-7	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	13.9 mg/L (Rat) 4 h
Octane 111-65-9	-	-	118 g/m³ (Rat) 4 h
1,2,3-Trimethylbenzene 526-73-8	-	-	-
Naphthalene 91-20-3	490 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 340 mg/m³ (Rat) 1 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

NAPHTHAS: In a large epidemiological study on over 15,000 employees at several petroleum refineries and amongst residents located near these refineries, no increased risk of kidney cancer was observed in association with gasoline exposures (a similar material). In a similar study, no increased risk of kidney cancer was observed among petroleum refinery workers, but there was a slight trend in the incidence of kidney cancers among service station employees, especially after a 30-year latency period. Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage (so-called Petrol Sniffer's Encephalopathy), delirium, seizures, and sudden death have been reported from repeated overexposure to some hydrocarbon solvents, naphthas, and gasoline.

ISOPARAFFINS: Studies in laboratory animals have shown that long-term exposure to similar materials (isoparaffins) can cause kidney damage and kidney cancer in male laboratory rats. However, in-depth research indicates that these findings are unique to the male rat, and that these effects are not relevant to humans.

C9 AROMATIC HYDROCARBONS: A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm.

PENTANES: Studies of pentane isomers in laboratory animals indicate exposure to extremely high levels (roughly 10 vol.%) may induce cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

BUTANES: Studies in laboratory animals indicate exposure to extremely high levels of butanes (1-10 or higher vol.% in air) may cause cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

TOLUENE: Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Abuse of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system, and can cause CNS depression, cardiac arrhythmias, and death. Studies of workers indicate longterm exposure may be related to impaired color vision and hearing. Some studies of workers suggest longterm exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest longterm exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals have been largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long-term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Adverse effects on the liver, kidney, thymus and nervous system were observed in animal studies following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

XYLENES, ALL ISOMERS: Overexposure to xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Effects may be increased by the use of alcoholic beverages. Evidence of liver and kidney impairment were reported in workers recovering from a gross overexposure. Effects from Prolonged or Repeated Exposure: Impaired neurological function was reported in workers exposed to solvents including xylene. Studies in laboratory animals have shown evidence of impaired hearing following high levels of exposure. Studies in laboratory animals suggest some changes in reproductive organs following high levels of exposure but no significant effects on reproduction were observed. Studies in laboratory animals indicate skeletal and visceral malformations, developmental delays, and increased fetal resorptions following extremely high levels of maternal exposure with evidence of maternal toxicity. The relevance of these observations to humans is not clear at this time. Adverse effects on the liver, kidney, bone marrow (changes in blood cell parameters) were observed in laboratory animals following high levels of exposure. The relevance of these observations to humans is not clear at this time.

1,2,4-TRIMETHYLBENZENE: The following information pertains to a mixture of C9 aromatic hydrocarbons, over 40% of which was composed of 1,2,4-trimethylbenzene. A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm. Embryotoxicity has been reported in studies of laboratory animals. Adverse effects included increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate.<n><n>

N-HEXANE: Long-term or repeated exposure to n-hexane can cause peripheral nerve damage. Initial symptoms are numbness of the fingers and toes. Also, motor weakness can occur in the digits, but may also involve muscles of the arms, thighs and forearms. The

onset of these symptoms may be delayed for several months to a year after the beginning of exposure. Testicular atrophy and partial to full loss of the germ cell line were observed in sub-chronic high-dose inhalation studies of laboratory rodents. These effects appeared irreversible. Rodent reproduction studies have shown evidence of reduced fetal weight but no frank malformations.

CUMENE: Overexposure to cumene may cause upper respiratory tract irritation and CNS depression. Studies in laboratory animals indicate evidence of respiratory tract hyperplasia, and adverse effects on the liver, kidney and adrenal glands following high level exposure. The relevance of these findings to humans is not clear at this time. Findings from lifetime laboratory rodent inhalation studies were as follows: In F344/N rats: an increased incidence of renal carcinomas and adenomas, respiratory epithelial adenomas, and interstitial cell adenomas of the testes. In B6C3F1 mice: an increased incidence of carcinomas and adenomas of the bronchi and lung, liver neoplasms, hemangiosarcomas of the spleen, and adenomas of the thyroid.

ETHYLBENZENE: Findings from a 2-year inhalation study in rodents conducted by NTP were as follows: Effects were observed only at the highest exposure level (750 ppm). At this level the incidence of renal tumors was elevated in male rats (tubular carcinomas) and female rats (tubular adenomas). The incidence of tumors was also elevated in male mice (alveolar and bronchiolar carcinomas) and female mice (hepatocellular carcinomas). IARC has classified ethyl benzene as "possibly carcinogenic to humans" (Group 2B). Studies in laboratory animals indicate some evidence of post-implantation deaths following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate limited evidence of renal malformations, resorptions, and developmental delays following high levels of maternal exposure with evidence of maternal toxicity. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals have demonstrated evidence of ototoxicity (hearing loss) following exposure levels as low as 300 ppm for 5 days. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland.

BENZENE: Studies of workers exposed to benzene show clear evidence that overexposure can cause cancer and other diseases of the blood forming organs including Acute Myelogenous Leukemia (AML), and Aplastic Anemia (AA), an often fatal disease. Some studies suggest overexposure to benzene may also be associated with Myelodysplastic Syndrome (MDS). Findings from a case control study of workers exposed to benzene was reported during the 2009 Benzene Symposium in Munich included an increase in Acute Myeloid Leukemias and Non-Hodgkins Lymphoid Neoplasms (NHLN) of the subtype follicular lymphoma (FL) in some occupational categories. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of AA have been reported in the offspring of persons severely overexposed to benzene. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and minor skeletal variations. Benzene has been classified as a proven human carcinogen by OSHA and a Group 1 (Carcinogenic to Humans) material by IARC. The current proposed IARC classification for benzene is summarized as follows: Sufficient evidence for Acute Myeloid Leukemia; limited evidence for Acute Lymphatic Leukemia, Chronic Lymphatic Leukemia, Non-Hodgkin Lymphoma, and Multiple Myeloma.

NAPHTHALENE: Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from overexposure to naphthalene. Persons with glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have

been reported in persons overexposed to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect. Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) in vitro. Naphthalene has been classified as Possibly Carcinogenic to Humans (2B) by IARC, based on findings from studies in laboratory animals.

CARBON MONOXIDE: is a chemical asphyxiant with no warning properties (such as odor). At 400-500 ppm for 1 hour headache and dyspnea may occur. If activity is increased, symptoms of overexposure may include nausea, irritability, increased respiration, tinnitus, sweating, chest pain, confusion, impaired judgement, dizziness, weakness, drowsiness, ataxia, irregular heart beat, cyanosis and pallor. Levels in excess of 1000 ppm can result in collapse, loss of conciousness, respiratory failure and death. Extremely high concentrations (12,800 ppm) can cause immediate unconsciousness and death in 1-3 minutes. Repeated anoxia can lead to central nervous system damage and peripheral neuropathy, with loss of sensation in the fingers, amnesia, and mental deterioration and possible congestive heart failure. Damage may also occur to the fetus, lung, liver, kidney, spleen, cardiovascular system and other organs.

WHOLLY-VAPORIZED UNLEADED GASOLINE: Lifetime exposure to wholly vaporized unleaded gasoline produced an increased incidence of liver tumors in female mice exposed to the highest exposure concentration (2056 ppm) and α-2 urinary globulin-mediated kidney tumors in male rats. No exposure-related tumors were observed in male mice or female rats. The male-specific rat kidney tumors are not considered relevant to human health. Mice receiving lifetime repeated skin application of various petroleum naphthas exhibited an irritation-dependent increased incidence of skin tumors. Additional studies suggest that these tumors occur through a mechanism that may not be relevant to human health. Epidemiological data from over 18,000 petroleum marketing and distribution workers showed no increased risk of leukemia, multiple myeloma, or kidney cancer resulting from gasoline exposure. Unleaded gasoline has been identified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

COMBUSTION ENGINE EXHAUST: Chronic inhalation studies of gasoline engine exhaust in mice, rats and hamsters did not produce any carcinogenic effects. Condensates/extracts of gasoline engine exhaust produced an increase in tumors compared to controls when testing by skin painting, subcutaneous injection, intratracheal instillation or implantation into the lungs. Gasoline exhaust has been classified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and Symptoms Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects May cause genetic defects.

Carcinogenicity May cause cancer.

Cancer designations are listed in the table below

Name	ACGIH	IARC	NTP	OSHA

	(Class)	(Class)		
Gasoline 86290-81-5	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Heptane (mixed isomers) 142-82-5	Not Listed	Not Listed	Not Listed	Not Listed
Butane (mixed isomers) 106-97-8	Not Listed	Not Listed	Not Listed	Not Listed
Pentane (mixed isomers) 78-78-4	Not Listed	Not Listed	Not Listed	Not Listed
Hexane Isomers (other than n-Hexane) 107-83-5	Not Listed	Not Listed	Not Listed	Not Listed
Toluene 108-88-3	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
n-Hexane 110-54-3	Not Listed	Not Listed	Not Listed	Not Listed
Cumene 98-82-8	Not listed	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not listed
1,2,4 Trimethylbenzene 95-63-6	Not Listed	Not Listed	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen
Cyclohexane 110-82-7	Not Listed	Not Listed	Not Listed	Not Listed
Octane 111-65-9	Not Listed	Not Listed	Not Listed	Not Listed
1,2,3-Trimethylbenzene 526-73-8	Not Listed	Not Listed	Not Listed	Not Listed
Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure Respiratory system. Central nervous system.

Specific Target Organ Toxicity (STOT) - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Gasoline 86290-81-5	72-hr EC50 = 56 mg/l Algae	96-hr LC50 = 11 mg/l Rainbow trout (static)	-	48-hr LC50 = 7.6 mg/l Daphnia magna
Heptane (mixed isomers) 142-82-5	-	96-hr LC50 = 375 mg/L Tilapia	-	-
Butane (mixed isomers) 106-97-8	-	-	-	-
Pentane (mixed isomers) 78-78-4	-	96-hr LC50 = 3.1 mg/L Rainbow trout	-	48-hr EC50 = >1 - <10 mg/L Daphnia magna
Hexane Isomers (other than n-Hexane) 107-83-5	-	-	-	-
Toluene	72-hr EC50 = 12.5 mg/l	96-hr LC50 <= 10 mg/l	-	48-hr EC50 = 5.46-9.83 mg/l

108-88-3	Algae	Rainbow trout		Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)
Xylene (mixed isomers) 1330-20-7	72-hr EC50 = 11 mg/l Algae	96-hr LC50 = 8 mg/l Rainbow trout	-	48-hr LC50 = 3.82 mg/l Daphnia magna
n-Hexane 110-54-3	-	96-hr LC50 = 2.5 mg/l Fathead minnow	-	-
Cumene 98-82-8	72-hr EC50 = 2.6 mg/l Algae	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	-	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)
1,2,4 Trimethylbenzene 95-63-6	-	96-hr LC50 = 7.19-8.28 mg/l Fathead minnow (flow-through)	-	48-hr EC50 = 6.14 mg/L Daphnia magna
Ethylbenzene 100-41-4	72-hr EC50 = 1.7-7.6 mg/l Algae	96-hr LC50 = 4 mg/L Rainbow trout	-	48-hr EC50 = 1-4 mg/L Daphnia magna
Benzene 71-43-2	72-hr EC50 = 29 mg/l Algae	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	-	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)
Cyclohexane 110-82-7	72-hr EC50 = 500 mg/l Algae	96-hr LC50 = 3.96-5.18 mg/l Fathead minnow	-	48-hr EC50 = 1.7-3.5 mg/L Bay shrimp
Octane 111-65-9	-	-	-	48-hr LC50 = 0.38 mg/l Daphnia magna
1,2,3-Trimethylbenzene 526-73-8	-	96-hr LC50 = 7.72 mg/l Fathead Minnow (flow-through)	-	-
Naphthalene 91-20-3	-	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	-	48-hr LC50 = 1.6 mg/l Daphnia magna

Persistence and degradability Expected to be inherently biodegradable. The presence of ethanol in this product may impede the biodegradation of benzene, toluene, ethylbenzene and xylene in groundwater, resulting in elongated plumes of these constituents.

Bioaccumulation Has the potential to bioaccumulate.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper Shipping Name:	Gasoline
UN/Identification No:	UN 1203
Class:	3
Packing Group:	II

TDG (Canada):

UN Proper Shipping Name:	Gasoline
UN/Identification No:	UN 1203
Transport Hazard Class(es):	3
Packing Group:	II

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Gasoline	NA
Heptane (mixed isomers)	NA
Butane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Toluene	NA
Xylene (mixed isomers)	NA
n-Hexane	NA
Cumene	NA
1,2,4 Trimethylbenzene	NA
Ethylbenzene	NA
Benzene	NA
Cyclohexane	NA
Octane	NA
1,2,3-Trimethylbenzene	NA
Naphthalene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Gasoline	NA
Heptane (mixed isomers)	NA
Butane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Toluene	1000 lb final RQ 454 kg final RQ
Xylene (mixed isomers)	100
n-Hexane	5000
Cumene	5000
1,2,4 Trimethylbenzene	NA
Ethylbenzene	1000

Benzene	10
Cyclohexane	1000
Octane	NA
1,2,3-Trimethylbenzene	NA
Naphthalene	100 lb final RQ 45.4 kg final RQ

SARA Section 311/312: The following EPA hazard categories apply to this product:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Gasoline	None
Heptane (mixed isomers)	None
Butane (mixed isomers)	None
Pentane (mixed isomers)	None
Hexane Isomers (other than n-Hexane)	None
Toluene	1.0 % de minimis concentration
Xylene (mixed isomers)	1.0 % de minimis concentration
n-Hexane	1.0 % de minimis concentration
Cumene	1.0 % de minimis concentration
1,2,4 Trimethylbenzene	1.0 % de minimis concentration
Ethylbenzene	0.1 % de minimis concentration
Benzene	0.1 % de minimis concentration
Cyclohexane	1.0 % de minimis concentration
Octane	None
1,2,3-Trimethylbenzene	None
Naphthalene	0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Gasoline

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0957
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0957 TPQ: 10000 lb (Under N.J.A.C. 7:1G, environmental hazardous substances in mixtures such as gasoline or new and used petroleum oil may be reported under these categories)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Heptane (mixed isomers)

Louisiana Right-To-Know:	Not Listed

California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1339
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Butane (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0273
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 0273 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Pentane (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1064
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 1064 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Hexane Isomers (other than n-Hexane)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1285
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present

Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Toluene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Developmental toxicity, initial date 1/1/91 Female reproductive toxicity, initial date 8/7/09
New Jersey Right-To-Know:	SN 1866
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree; Teratogen
New Jersey - Environmental Hazardous Substances List:	SN 1866 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Xylene (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 2014
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold all isomers
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 2014 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

n-Hexane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1340
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed

Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 1340 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1 lb RQ (air); 1 lb RQ (land/water)

Cumene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/6/10
New Jersey Right-To-Know:	SN 0542
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0542 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	5000 lb RQ (air); 1 lb RQ (land/water)

1,2,4 Trimethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Ethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 6/11/04
New Jersey Right-To-Know:	SN 0851
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed

New Jersey - Special Hazardous Substances:	Carcinogen; flammable - Third degree
New Jersey - Environmental Hazardous Substances List:	SN 0851 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Benzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 2/27/87 Developmental toxicity, initial date 12/26/97 Male reproductive toxicity, initial date 12/26/97
New Jersey Right-To-Know:	SN 0197
Pennsylvania Right-To-Know:	Environmental hazard; Special hazardous substance
Massachusetts Right-To Know:	Carcinogen; Extraordinarily hazardous
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin); Carcinogen (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Carcinogen; Extraordinarily hazardous
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Present
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen
New Jersey - Environmental Hazardous Substances List:	SN 0197 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	10 lb RQ (air); 1 lb RQ (land/water)

Cyclohexane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0565
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0565 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Octane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1434
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous	Not Listed

Substances List:	
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
1,2,3-Trimethylbenzene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Naphthalene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/19/02
New Jersey Right-To-Know:	SN 1322 SN 3758
Pennsylvania Right-To-Know:	Environmental hazard Present (particulate)
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen
New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ: 500 lb (Reportable at the de minimis quantity of >0.1%)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	100 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all of the information required by those regulations.

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Gasoline	B2,D2A,D2B	0.1%
Heptane (mixed isomers)	B2,D2B	1%
Butane (mixed isomers)	A,B1	1%
Pentane (mixed isomers)	B2	1%
Hexane Isomers (other than n-Hexane)	B2	1%
Toluene	B2,D2A,D2B	0.1%
Xylene (mixed isomers)	B2,D2A,D2B	m-, o-isomers 1.0%; p-isomer 0.1%
n-Hexane	B2,D2A,D2B	1%

Cumene	B2,D2A	0.1%
1,2,4 Trimethylbenzene	B3,D2B	1%
Ethylbenzene	B2,D2A,D2B	0.1%
Benzene	B2,D2A,D2B	0.1%
Cyclohexane	B2,D2B	1%
Octane	B2,D2B	1%
1,2,3-Trimethylbenzene	B3	1%
Naphthalene	B4,D2A	0.1%

Note: Not applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety

Revision Notes

Revision Date 06/01/2016

Disclaimer

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Ambient Air Monitoring Plan

Drum Remediation
Neuhauser Landfill
1831 Weld County Road 5
Erie, Colorado 80516

December 05, 2017

Prepared for:

GEOSYNTEC CONSULTANTS, INC.

5670 Greenwood Plaza Blvd., Suite 540
Greenwood Village, Colorado 80111

On Behalf of:
Stratus Redtail Ranch, LLC

Prepared by:

PSC Industrial Outsourcing, LP
6511 Colorado Blvd., Unit 2
Commerce City, Colorado 80022

Project #: 624-1711-0001-J0004

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1 INTRODUCTION

This Ambient Air Monitoring Plan (AAMP) was prepared by PSC Industrial Outsourcing, LP (PSC) for Geosyntec Consultants, Inc. (Geosyntec) on behalf of Stratus Redtail Ranch LLC (Stratus), to meet the requirements of the Administrative Settlement Agreement and Order on Consent (AOC) entered into voluntarily by the United States Environmental Protection Agency (EPA) and Stratus for removing buried drums that have been identified at the Neuhauser Landfill located at 1831 Weld County Road 5, Erie, Weld County, Colorado (Site). Figure 1 presents the Site Vicinity Map.

This AAMP has been prepared to accommodate the Drum Removal Work Plan (DRWP), which provides a description of, an expeditious schedule for, and the actions required by paragraph 27 of the AOC, including: excavation and removal of buried drums; overpacking of leaking drums as necessary to prevent further releases; sampling and characterization of drum contents for disposal purposes; safe storage of the drums pending laboratory results and disposal arrangements; transport and disposal of the drums at facilities in compliance with the CERCLA off-site disposal rule within 30 days of excavation; inventorying of drum contents and recording of excavation GPS coordinates; and minimizing emissions of volatile organic compounds (VOCs) to the ambient air. This drum removal action also includes removal of soils contaminated by leaking drums, if any, and removal of a deposit of black sludge, as described in Section 4.1. Hence, this AAMP is to provide the means to monitor and minimize emissions of VOCs to the ambient air during the drum removal remediation activities.

This AAMP is to be implemented in conjunction with the DRWP and the following documents, as required by the AOC:

- Sampling and Analysis Plan (SAP),
- Quality Assurance Project Plan (QAPP),
- Field Sampling Plan (FSP),
- Health and Safety Plan (HASP),
- Site Management Plan (SMP), and
- Storm Water Pollution Prevention Plan (SWPPP).

1.1 Site Location, Conditions, and History

The Site is located on the northwest corner of County Roads (CR) 4 and 5 in Erie, Weld County, Colorado (Section 29, Township 1 North, Range 68 West). The Site consists of approximately 290 acres of undeveloped grassland, except for gravel access roads and ongoing oil and gas production operations. The Site, previously known as the Pratt Property

and the Erie Farm, is bounded by the Front Range landfill on the east side of CR5, residential properties to the south of CR4, and the Denver Regional Landfill and Old Erie Landfill to the north and northwest of the Site, respectively.

The ground surface at the Site generally slopes from east to the west. Surface water generally flows to the west toward unnamed drainages on the south and north sides of the Site, which flow northwest to Coal Creek, which is tributary to Boulder Creek. Silt and clay soils generally overlie weathered claystone, siltstone, and sandstone bedrock, encountered at depths of 1 to 14 feet below ground surface in borings drilled at the Site (Stewart, 2017b). Shallow groundwater is present in perched pockets within depressions in the bedrock surface.

Based on previous investigations (e.g., Stewart 2017a, 2017b), the northern portion of the Site was operated as a landfill by Sanitation Engineering, Inc. in the 1960s (known as the Erie Landfill), which accepted drums for disposal until early 1969. The AOC states that up to 1,500 drums containing 84,000 gallons of chemical waste from various entities, including the International Business Machine Company (IBM), may have been disposed at the Neuhauser Landfill during this period, based on IBM responses to EPA requests for information in 1985 (?).

Stratus acquired the Site in 2015, and subsequently conducted several environmental investigations in coordination with the Colorado Department of Public Health and Environment (CDPHE), including electromagnetic (EM) geophysical surveys and test pitting and sampling of drum contents, sludge, and impacted soils. According to Stewart (2017b), VOCs, primarily methyl ethyl ketone ((MEK), also known as 2-butanone) and toluene were detected in samples of drum liquids and sludges, in sludge samples, and in soil samples. The MEK and toluene concentrations in the liquid from the drums exceeded Resource Conservation and Recovery Act (RCRA) hazardous waste toxicity characteristic criteria.

The EM surveys identified two primary areas of historic drum disposal. Based on the size of the larger of the two disposal areas and a presumption that the drums are not vertically stacked, Stewart (2017b) estimated that approximately 100 to 150 drums are buried at the Site, rather than the 1,500 drums indicated in the AOC.

The Site is currently zoned low density residential. Access to the Site is currently unrestricted (i.e., no perimeter fence) and no gated entrances. People potentially exposed to conditions at the Site include visitors, oil and gas well workers, and any trespassers. Wildlife habitats (e.g., prairie dogs) exist throughout the Site. Unregulated wetlands lie approximately 300 feet west of the anticipated drum removal area.

1.2 Ambient Air Monitoring Objectives

The ambient air-monitoring program described in this AAMP will include the real-time measurement and the time-integrated sampling of the concentrations of airborne volatile

contaminant constituents at the project perimeter during the remediation. The real-time data will be compared to site-specific action levels established to determine if additional emission control measures are necessary. The time-integrated air sampling data collected during the remediation will be compared to baseline pre-remediation local air quality data and to project specific risk-based air quality objectives established for the project.

The specific tasks to be completed to achieve the objectives of the air-monitoring program include:

- *Baseline Pre- and Post-Remediation Time-Integrated Air Sampling* – The objective of pre-remediation baseline air sampling is to document typical air quality at the Site prior to the start of remedial activities. The pre-remediation baseline sampling will be performed prior to the beginning of remedial actions and the data will be used to compare pre-remediation air quality data with air quality conditions measured during remediation activities. Post-remediation baseline sampling will be performed to verify that the air quality at the Site is consistent with the pre-remediation baseline air quality at the conclusion of the remediation activities, which includes either the confirmation of floor and wall soil samples meeting the remedial objectives or the backfilling of clean material in the excavated areas.

- *Real-time Ambient Air Monitoring* – Real-time ambient air quality monitoring for total VOCs will be performed at the perimeter of the exclusion zone and the project perimeter when remedial activities are occurring to document the air quality conditions outside of the exclusion zone. Real-time air monitoring will be compared to site-specific action levels to determine if the implementation of additional emission control measures is necessary.

- *Time-Integrated Ambient Air Sampling* – Time-integrated air sampling will be conducted throughout the remediation at the perimeter air monitoring stations for approximately 72-hour periods for the collection of air samples. Samples will be analyzed for VOCs.

- *Meteorological Monitoring* – A meteorological monitoring station will be established to monitor weather conditions throughout the duration of the project, including the baseline monitoring, monitoring during the remediation activities, and the post-remediation monitoring.

2 AMBIENT AIR MONITORING PROGRAM

The perimeter air monitoring will be conducted during the pre-remediation baseline, the active remediation, and the post-remediation phases of the project using time-integrated sample collection methods and real-time measurement instruments.

Real-time air monitoring will be conducted at regular intervals throughout the workday to monitor measured concentrations of photo-ionizable (volatile) vapors. The real-time air quality data will be collected to assess air quality conditions at the project perimeter during the work day to identify if site activities are adversely affecting local air quality and to identify when the implementation of additional emission control measures may be necessary.

Time-integrated sampling will be conducted 24-hours per day to measure VOCs. The samples will be analyzed to document concentrations of VOCs at the project perimeter relative to air quality towards off-property receptors.

2.1 Air Monitoring Locations

Four perimeter air monitoring station (AMS) locations identified as AMS-1 through AMS-4 will be placed at intervals along the project perimeter at approximate locations as shown on Figure 2. The AMS will be at locations in which sampling equipment for the collection of time-integrated air samples using USEPA Method TO-15 for VOCs. To satisfy project-specific quality assurance and quality control (QA/QC) sampling requirements, a duplicate station (AMS-4D) will be co-located at the AMS-4 location, which is the general predominant down-wind location towards adjacent active landfills, as potential receptors. The real-time air monitoring will be conducted at the four AMS, as well as at the entire perimeter during periodic walks. The project perimeter line and/or exclusion zone fenceline will have grid-like markers positioned on them to serve as a position locator while taking real-time measurements as intermediate locations between the four AMS.

Placement of the AMS will be based on locating them along each primary site boundary corresponding to the site orientation while also incorporating the configuration of the property and the predominant wind direction for the months of December to January. The AMS locations selected should provide representative data of ambient air quality at the project perimeter of the Site. The potential receptors are identified on Figure 1.

Prevailing wind directions based on historical meteorological data were collected from WeatherSpark.com and WindHistory.com. The historical weather data was reviewed to assist with conceptually locating the monitoring stations. Historical weather data for the months of January through December annually as well as for the individual months of December and January indicate predominant wind directions are from the west and northwest. Thus, the predominant downwind direction is towards the east and southeast. Wind rose diagrams for

the vicinity of historical prevailing wind directions for the months of December through January is provided in Appendix A.

Time-integrated sampling equipment will be securely placed at each AMS. The position of the sampler inlet will be situated approximately six feet above ground surface in an unobstructed breathing zone in accordance with USEPA guidance (Air/Superfund National Technical Guidance Study Series, Volume IV, EPA-45 1 /R-93-007, May 1993). The stationary samplers will be positioned at each selected location using the following criteria:

- Located along the fence line where possible;
- The sample inlet will be placed approximately two meters above the ground;
- The monitor will be located at a minimum of two meters from the nearest solid obstruction to allow airflow, and two times the height of the obstruction where possible;
- When possible, the immediate surroundings will have ground cover to prevent surface dust from affecting the measurements;
- The samples will be installed with suitable accessibility, and will receive unrestricted airflow from at least three cardinal wind directions (270°), including the predominant wind direction;
- The samples will be located away from combustion or fuel sources, when possible; and,
- General 24-hour safety from being compromised.

Site-specific locations will be determined during setup at the Site using the above criteria. Based on the limited space available, meeting all of the above criteria may not be possible at all sampling locations. The locations will be selected to minimize interference of obstructions. Air sampling stations may be temporarily relocated, if stations interfere with excavation or other activities. If air sampling stations are relocated, the relocation needs and details will be documented.

2.2 Real–Time Air Monitoring

Real-time monitoring for VOCs will be conducted at the four AMS locations, along the perimeter, and at the exclusion zone fenceline on all days when remediation activities are in progress and during the hours of operation. Real-time air monitoring will be conducted at the start of each work day and throughout the work day on an approximate hourly basis (in general) until the end of each work day.

During hourly real-time perimeter air monitoring, the field technician will record current meteorological conditions from the on-site meteorological monitoring station.

Real-time monitoring for VOCs will be conducted using a ppbRAE or MiniRAE portable photoionization detector (PID) with a 10.6ev lamp (or equivalent, as appropriate). The PID will be used to non-selectively monitor VOC concentrations at the exclusion zone perimeter. The PID will generally have a detection limit of 1.0 part-per-billion (ppb).

The PID will be used to monitor air quality along the perimeter. The PID air quality measurements will be collected from the “breathing zone” (4’ to 6’ above ground surface) at each AMS and throughout the perimeter walk. The field technician will point the instrument toward the open excavation or any stockpile area, the instrument will be allowed to equilibrate. Instrument readings will be measured over a one-minute sample interval at each location and the average concentration will be recorded manually to data sheets. The Hourly Air Monitoring Data Form (Appendix B) will be used to record measured concentrations.

2.3 Time-Integrated Sampling

Time-Integrated ambient air sampling will be conducted using stationary samplers at each AMS located along the perimeter for the collection of samples for laboratory analysis. A description of the time-integrated air sampling methods and equipment are provided in the following subsections.

2.3.1 Sample Frequency and Duration

Time-integrated ambient air sampling will be conducted over approximate 72-hour periods, during active work days each week throughout the remediation. Air sampling will be concluded once all excavation and impacted soil handling activities have been completed and the excavated area has been either backfilled or confirmation floor and wall soil samples have met the remedial objectives. Air monitoring activities will not be conducted during site restoration. Baseline sampling events will be completed prior to the start of site remediation activities and at the conclusion of site remediation activities to document local air quality conditions.

2.3.2 Baseline Time-Integrated Sampling

Baseline time-integrated air sampling will be conducted to characterize local area air quality prior to the start of remediation activities. The baseline ambient air sampling will consist of two 72-hour time-integrated sampling events, and meteorological monitoring during a six-day period before intrusive remediation activities begin. Time-integrated samples for off-site laboratory analysis will be collected from each AMS at the end of each 72-hour baseline monitoring period. Samples will be collected at each AMS location and the duplicate AMS location.

The baseline time-integrated air sampling will be repeated at the conclusion of the remediation. The post-remediation baseline ambient air sampling will also consist of two 72-hour time-integrated sampling events. Meteorological monitoring will also be conducted during a six-day period after intrusive site remediation activities are completed and final excavation backfilling. Time-integrated samples for off-site laboratory analysis will be collected from each AMS at the end of each 72-hour baseline monitoring period. Samples will be collected at each AMS location and the duplicate AMS location.

2.3.3 Sample Collection and Analysis

At each AMS location, sample media will be installed for the collection of air samples for analysis of VOCs. Following the completion of each time-integrated sampling event, the samples will be packaged and prepared for overnight delivery to the analytical laboratory selected for the project. Chain-of-custody forms and the Ambient Air Monitoring Sheet will accompany all samples during shipment. Air monitoring documentation forms are included in Appendix B.

Sampling and laboratory analysis for VOCs will be completed in accordance with USEPA Methods TO-15. The sample media consist of one 6-Liter SUMMA canister at each AMS. The flow rates of ambient air entering the SUMMA canister will be based on 72-hour events and the flow rates are governed by laboratory calibrated flow controllers. The general VOC compounds to be analyzed and the approximate laboratory reporting limits for each analyte are presented in Appendix C.

Samples will be shipped to the laboratory within 24 hours of collection and analyzed within recommended holding times, unless a sampling event is completed on the weekend or a holiday. If a sampling event is completed on a weekend or holiday, the sample media will be shipped to the lab the next business day.

Sample analyses will generally be performed on a standard turn-around-time (TAT) when appropriate. The standard TAT is generally 10 business days from sample receipt at the laboratory. However, certain sampling events may need to have the analyses performed on a faster TAT. Such events include the pre-remediation baseline events and the first active remediation event(s). For these, the TAT may be reduced to one day up to one week to ensure that data is received to make appropriate site activity decisions.

2.4 Meteorological Monitoring

A Davis Instruments self-contained digital meteorological system (or equivalent) will be used to measure and record wind speed, wind direction, ambient temperature, relative humidity, precipitation as rain, and barometric pressure at 10-second intervals. The recorded measurements will be averaged over 60-minute increments by the system's internal software. The 60-minute average measurements for each meteorological parameter will be stored in

the Weatherlink data logger and downloaded periodically. The available information will be documented with the hourly real-time documentation.

The meteorological system will be mounted on either a 10-foot aluminum mast or a 10-foot tripod (or equivalent) depending upon the monitoring location selected. The monitoring location will be selected to minimize interferences from surrounding natural or man-made obstructions. The mast or tripod mounted system will be equipped with a lightning rod and grounding system. The system is solar powered and utilizes backup batteries.

Installation and operation of the meteorological monitoring system will be conducted in accordance with manufacturer specifications. Data collected during the monitoring program will be routinely screened for potential operational problems. General weather conditions will also be recorded daily on the air monitoring field forms.

2.5 Quality Assurance/Quality Control

The following sections provide a brief description of the QA/QC procedures to be implemented for the ambient air monitoring program.

2.5.1 QA/QC Samples

Laboratory QC will be in accordance with the requirements for the specified analytical methods. Laboratory analytical data packages including QC batch summaries with control limits will be provided for all analyses completed by the laboratory.

Field QC samples will be collected as part of the QA procedures to ensure that quality objectives are met. Field QA/QC sample frequency is provided below.

Field Duplicates

One set of duplicate samples will be collected during the pre- and post-remedial baseline sampling events. Duplicate sample sets will be collected at the co-located station AMS-4D at a minimum 10 percent frequency rate of sampling at all AMS during the time-integrated air sampling program throughout the project. With a total of four AMS locations, a duplicate sample set will be collected approximately during every other sampling event.

2.5.2 Instrument Calibration and Checks

Periodic calibrations and checks are required on the PID field instruments and equipment to be used for the ambient air monitoring program. Daily instrument calibrations, or calibration checks, will be conducted at the beginning of each shift. The calibration results will be recorded in the calibration log form provided in Appendix B. The following sections provide a brief description of the calibrations and checks required for each piece of equipment.

Photoionization Detector

The PID will be calibrated daily using 10 ppm isobutylene calibration gas and in accordance with the manufacturer's guidelines. Span checks will be completed as necessary throughout the day to verify calibration of the instrument. Instrument calibration will be recorded on the calibration log form.

Meteorological Weather Station

Meteorological sensors will be NIST calibrated by the manufacturer or supplier and properly oriented in accordance with manufacturer instructions. Weather conditions will be recorded hourly on the air monitoring field forms and the meteorological data will also be stored in the system's data logger.

3 AMBIENT AIR ACTION LEVELS

Site-specific action levels for real-time air monitoring and air quality objectives for time-integrated air sampling have been established for the remediation project. Real-time monitoring action levels were selected to maintain perimeter air quality at an acceptable level during remedial activities. The action levels have been established to identify occasions when additional emissions abatement measures will be required to control site emissions sufficiently such that the air quality is not adversely affected relative to the project air quality objectives. The real-time monitoring action levels will be used in association with tiered response measures in order to implement increasingly more rigorous emissions abatement measures to help prevent exceedances of the project air quality objectives.

Project specific air quality objectives have been calculated using risk-based exposure equations for inhalation. Air quality objectives have been calculated for specific VOCs (MEK toluene, and trichloroethylene) that may potentially be present as emissions at the Site, based on previous investigative data analyses. These specific VOC concentrations will be obtained from the laboratory analyses of the time-integrated samples. These specific VOC concentrations will be evaluated and tracked throughout the project and compared to the project-specific air quality objectives. These potential “target contaminants” were selected to regularly monitor the performance of the project emissions abatement measures in meeting the air quality objectives. The project specific air quality objectives will be used to verify that local air quality is not being impacted by the remediation project.

3.1 Real-Time Action Levels

The real-time air monitoring action levels have been developed to serve as indicators to identify when emission control responses will be necessary. Real-time action levels have been developed for total VOCs (as measured by field instruments). The real-time action levels have been developed using air quality workplace and ambient air standards, and the capability of the field screening instruments.

Action levels established for total VOCs are discussed in the following sections. The action levels were selected to maintain acceptable daily air quality at the Site, and reduce the potential for subsequent emissions at higher concentrations. A summary of the USEPA calculated site-specific Resident Screening Levels (RSL)s for Air is presented in Appendix D.

Real-time air action levels for VOCs have been established for the Site based on the NIOSH REL and the OSHA PEL values for MEK, toluene, and trichloroethylene. A real-time (sustained as a one minute average concentration) action level of 2.0 ppm (above background) has been selected as the level action level for total VOCs at the exclusion zone fenceline and 1.0 ppb (above background) at the project perimeter. Background values will be determined by the current readings obtained from the upgradient wind direction, generally from the west. The PID will be used to monitor non-specific concentrations of total photo-

ionizable volatiles present. The detection of photo-ionizable volatiles provides an indication of the potential presence of VOCs. PID readings at the exclusion zone fenceline and the project perimeter compared to the VOC action levels will be utilized to determine when additional measurements and emission abatement measures are necessary. The exclusion zone fenceline and project perimeter are depicted in Figure 2.

When sustained readings remain below either of the real-time action levels (RTAL)s, the air monitoring technician will continue the perimeter monitoring route. If a sustained reading greater than or equal to the RTALs during an initial measurement is obtained with the PID, a second measurement will be taken. If the PID sustained reading is not greater than or equal to the RTALs during the second one minute monitoring period, the monitoring technician will proceed to the next monitoring station on the fenceline or perimeter route. If the PID reading is greater than or equal to RTALs during the second measurement at a monitoring location, the air monitoring technician will pause for 5 minutes and then record a third measurement to assess if VOC levels may be attributable to a short-term transient condition or are more sustained.

If a PID reading greater than or equal to RTALs is obtained during the third measurement period, the technician will notify the remediation project managers so that first-tier action level abatement measures for VOCs will be implemented by the remediation contractor. A detailed description of the Site and surrounding area activities will be documented to evaluate possible VOC sources. Response actions to address conditions causing exceedances of the VOC action level are described in Section 3.3.

If PID measurements continue to be equal to or greater than the RTALs (above background) after the initial abatement measures have been incorporated, the air monitoring technician will notify the site managers to implement more rigorous abatement measures until VOC emissions decrease.

If the PID measurements do not decrease within an appropriate amount of time after the more rigorous abatement measures have been incorporated, the air monitoring technician will notify the site managers that a second-tier action level is to be implemented, in which the remediation activities will be suspended until a minimum of 30-minutes has passed with PID measurements being less than the action RTALs. Response actions to address conditions causing exceedances of the VOC action levels are described in Sections 3.3 and 3.4.

3.2 Time-Integrated Air Quality Objectives

The time-integrated sampling will be used to document air quality at the project perimeter during the remedial action to identify potential project related air emissions. The analytical results for each 72-hour sampling period will be tabulated to calculate running average air concentrations for total VOCs detected during the remedial activities. The running average air concentrations for the target constituents will serve as an ongoing measure of air quality at the perimeter over the project duration. The running averages for the target compounds will be compared to the baseline concentrations measured prior to the start of remedial actions

and the air quality objectives established for the target constituents. The comparison of the target compound running averages to the project air quality objectives will be used to identify when emission abatement measures need to be implemented on semi-permanent basis rather than the short-term implementation of abatement measures after real-time monitoring action level exceedances.

The air concentrations at each AMS will be compared to the baseline concentrations collected at the start of the project before remediation activities began and to the air quality objectives developed for the estimated project duration of 30 days (0.083 years). Project-specific air quality objectives presented in Appendix D have been developed for MEK, toluene, and TCE for this project. The time-integrated sampling results will be compared to the air quality objectives as they are received from the laboratory to assess the effectiveness of emission control efforts during remediation activities. Project running averages will be updated as the time-integrated sampling laboratory results are accumulated.

The project-specific air quality objective for target compounds MEK, toluene, and TCE have been developed using USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites on-line calculator for inhalation exposure for residents (11/15/2017). The exposure duration used was an estimated 30 days (0.083 years) based on the expected schedule for remedial activities to be completed. The calculator automatically evaluates and presents the most site-specific conservative screening levels. The general risk-based exposure equations that the calculator uses are as follows:

- **Resident Air**

  This land use is for developing residential default screening levels that are presented in the RSL Generic Tables.

  - Noncarcinogenic
- Inhalation

$$SL_{res\text{-}air\text{-}nc}\left(\mu g/m^3\right) = \frac{THQ \times AT_{res\text{-}a}\left(\frac{365\ days}{year} \times ED_{res}\left(26\ years\right)\right) \times \left(\frac{1000\ \mu g}{mg}\right)}{EF_{res}\left(\frac{350\ days}{year}\right) \times ED_{res}\left(26\ years\right) \times ET_{res}\left(\frac{24\ hours}{day}\right) \times \left(\frac{1\ day}{24\ hours}\right) \times \frac{1}{RfC\left(mg/m^3\right)}}$$

  - Carcinogenic
- Inhalation

$$SL_{res\text{-}air\text{-}ca}\left(\mu g/m^3\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{year} \times LT\left(70\ years\right)\right)}{EF_{res}\left(\frac{350\ days}{year}\right) \times ED_{res}\left(26\ years\right) \times ET_{res}\left(\frac{24\ hours}{day}\right) \times \left(\frac{1\ day}{24\ hours}\right) \times IUR\left(\mu g/m^3\right)^{-1}}$$

- Mutagenic
  - Inhalation

$$SL_{res\text{-}air\text{-}mu}\left(\mu g/m^3\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{year} \times LT\ (70\ years)\right)}{IUR\left(\mu g/m^3\right)^{-1} \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\begin{array}{l} \left(ED_{0\text{-}2}\ (2\ years) \times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right) \times ET_{0\text{-}2}\left(\frac{24\ hours}{day}\right) \times 10\right) + \\ \left(ED_{2\text{-}6}\ (4\ years) \times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right) \times ET_{2\text{-}6}\left(\frac{24\ hours}{day}\right) \times 3\right) + \\ \left(ED_{6\text{-}16}\ (10\ years) \times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right) \times ET_{6\text{-}16}\left(\frac{24\ hours}{day}\right) \times 3\right) + \\ \left(ED_{16\text{-}26}\ (10\ years) \times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right) \times ET_{16\text{-}26}\left(\frac{24\ hours}{day}\right) \times 1\right) \end{array}\right)}$$

- Trichloroethylene
  - Inhalation

$$SL_{res\text{-}air\text{-}tce}\left(\mu g/m^3\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{year} \times LT\ (70\ years)\right)}{IUR\left(\mu g/m^3\right)^{-1} \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\begin{array}{l} \left(ED_{res}\ (26\ years) \times EF_{res}\left(\frac{350\ days}{year}\right) \times ET_{res}\left(\frac{24\ hours}{day}\right) \times CAF_i\ (0.756)\right) + \\ \left(\begin{array}{l} \left(ED_{0\text{-}2}\ (2\ years) \times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right) \times ET_{0\text{-}2}\left(\frac{24\ hours}{day}\right) \times MAF_i\ (0.244) \times 10\right) + \\ \left(ED_{2\text{-}6}\ (4\ years) \times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right) \times ET_{2\text{-}6}\left(\frac{24\ hours}{day}\right) \times MAF_i\ (0.244) \times 3\right) + \\ \left(ED_{6\text{-}16}\ (10\ years) \times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right) \times ET_{6\text{-}16}\left(\frac{24\ hours}{day}\right) \times MAF_i\ (0.244) \times 3\right) + \\ \left(ED_{16\text{-}26}\ (10\ years) \times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right) \times ET_{16\text{-}26}\left(\frac{24\ hours}{day}\right) \times MAF_i\ (0.244) \times 1\right) \end{array}\right) \end{array}\right)}$$

Equation Definitions:

$\mu g/m^3$ = micrograms per cubic meter

TR = Target cancer risk level (1 per 1,000,000 occurrences)

AT = Averaging Time (days)

EF = Exposure Frequency (days)

ED = Exposure Duration (years)

ET = Exposure Time (24 hours)

IUR = Chronic Inhalation Unit Risk $(\mu g/m^3)^{-1}$

LT = Lifetime (70 years)

CAF_i = Adherence Factor, Cancerous

MAF_i = Adherence Factor, Mutagenic

THQ = Target Hazard Quotient (0.1)

Most of the potential receptors in the vicinity of the remediation Site are residential properties to the west and south, with additional landfill properties to the east and north of the remediation Site. As a conservative approach to deriving an acceptable maximum exposure level for the target contaminants, the USEPA RSL on-line calculator evaluates the various models and determines the most conservative screening level for each contaminant based on project-specific inputs. The exposure duration was based upon the estimated project duration of 30 days. Acceptable target risk exposure level concentrations based on the residential inhalation model is as follows.

- Methyl ethyl ketone (6,080 $\mu g/m^3$)
- Toluene (6,080 $\mu g/m^3$)
- Trichloroethylene (2.43 $\mu g/m^3$)

The target constituents listed above are presented since they are assumed to be the primary contaminants present. In general, other constituents may be present, but may not be considered as primary constituents. The air quality objective calculation parameters for the project-specific objectives are presented in Appendix D.

Considering that there are active landfills and fracking operations within the immediate vicinity of the project Site and residential properties, there is a likelihood that the baseline and active

remediation samples may report concentrations of various VOCs. In addition, County Road 5 passes approximately 40 feet from the air monitoring stations located on the east side of the project Site. Likewise, various trucks and excavating equipment will be using temporary roads built for transport during the field activities that run very close to some of the AMS, in addition to truck traffic associated with the landfill and fracking operations. The laboratory data will be evaluated and discussed with the EPA to determine concentrations contributable to remedial activities verses offsite traffic and activities.

3.3 Response to Action Level Exceedances

Emission controls will be implemented as necessary to maintain acceptable air quality at the exclusion zone fenceline and/or project perimeter. Real-time action levels developed for VOCs, as measured with a PID, will be used to gauge relative air quality at the exclusion zone fenceline (2 ppm) and the project perimeter (1 ppb). Emission control measures will be implemented in the event real-time action levels are exceeded. Emission controls are generally not implemented for exceedances reported in the time-integrated samples. This is because the analyses of the samples are not real time. The Site conditions have already changed by the time laboratory analyses can be completed. However, the data can still be used to re-evaluate emission controls for modification, such as the real-time action levels.

A real-time action level exceedance at the exclusion zone may require that the exclusion zone fenceline be modified to maintain the concentrations within the exclusion zone. The response actions taken to control off-site emissions will be proportional to the severity of the recorded real-time exceedance at the project perimeter and/or exclusion zone fenceline. The response actions for exceedances at the project perimeter are dynamic and presented in Section 3.4 and within the Drum Removal Work Plan and/or Site Management Plan. The frequency of real-time measurements collected will be increased until perimeter air quality no longer exceeds action levels. The on-site project managers and EPA will be notified of each action level exceedance causing applicable emission abatement measures to be implemented to reduce site emissions.

3.4 Emission Control Measures

If a real-time action level is exceeded, the initial step will be to assess potential sources or material handling procedures that may be contributing to the unfavorable conditions.

First-tier action levels abatement measures taken to reduce volatile emissions will include as necessary:

- Using cellulose/foam spray applications;
- Covering exposed soil surfaces with tarps, plastic sheeting, or clean fill;
- Reducing the area of exposed soils;
- Altering material handling procedures;
- Reducing the rate of production; and

- Moving the work to other areas of the Site until more favorable weather conditions or work practices can be implemented.

Second-tier action level abatement measures will be implemented if action levels are sustained over a 30-minute monitoring interval after the first-tier abatement measures have been incorporated. Thus, the work activities will be ceased until a minimum of 30-minutes has passed with PID measurements being less than the action RTALs or when an effective response can be implemented. Exceedances that cause work activity responses will be reported to the on-site EPA within 30 minutes of required action. The increased frequency of real-time air monitoring will be continued until air quality no longer exceeds action levels.

At the end of each work day, stockpiles and exposed soil surfaces will be covered to minimize emissions. Tarps, plastic sheeting, or cellulose/foam suppressant applications may be used, as applicable. The air monitoring technician will monitor air quality at each perimeter location to verify that action levels are not being exceeded before leaving the Site. The stockpile and excavation areas will be screened with the PID and inspected to assure that areas are properly covered.

4 DATA REPORTING

The following sections provide a description of the procedures that will be used for recording field data.

4.1 Field Documentation

Field documentation will be maintained throughout the project to accumulate site conditions on a daily basis that have or may influence site air quality conditions. Information to be recorded will include:

- Description of site activities;
- Weather conditions;
- General real-time perimeter monitoring observations;
- Action level exceedances; and
- Emission abatement measures implemented in response to action level exceedances.

The data recorded in the field documents will be supplemented by data recorded on specific real-time and time-integrated field data sheets. Air monitoring field data sheets and field forms are provided in Appendix B.

4.2 Real-Time Monitoring Data

The real-time air monitoring data will be recorded on the field data sheets and stored in an electronic database. Field data including measured concentrations recorded during perimeter air monitoring rounds, calibration records, maintenance, sampling irregularities, and repairs will be recorded on data sheets and compiled in the field logbook for the real-time air monitoring.

The real-time sampling results will be routinely reported to the site manager to allow prompt evaluation and response to potential emission problems when action levels have been approached or exceeded.

4.3 Time-Integrated Sampling Data

Field data, including equipment calibration, sample identification; equipment maintenance, sampling irregularities, and shipments will be recorded on the time-integrated sampling field data sheets and compiled in the field on Excel spreadsheets.

Preliminary results will be reported to the site manager to assess potential air quality concerns due to site activities.

4.4 Data Reporting

The real-time data and time-integrated laboratory results will be maintained in hard copy, on site, for available review by the EPA, the Colorado Department of Public Health and Environment (CDPHE), and the Town of Erie. Real-time action level exceedances, which cause emission control measures to be implemented will also be reported, as appropriate, by 10:00 am of the next working day after the exceedance occurred. Time-integrated objective exceedances will be reported likewise, upon reviewing and tabulating the results from the laboratory. The accumulated time-integrated results, field data, and comparison to the project air quality standards will be presented in the Ambient Air Monitoring Report upon the conclusion of the remediation project.

5 REFERENCES

Office of Air Quality Planning and Standards, 1998. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part 1, Ambient Air Quality Monitoring Program Quality System Development.* (EPA-415/R-98-004)

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A)(PDF) (289 pp, 6.9 MB). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002.

U.S. EPA 1991b. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals) (PDF) (68 pp, 721 K). Office of Emergency and Remedial Response. EPA/540/R-92/003. December 1991

U.S. EPA. 1997a. Exposure Factors Handbook (PDF) (854 pp, 7.7 MB). Office of Research and Development, Washington, DC. EPA/600/P-95/002Fa.

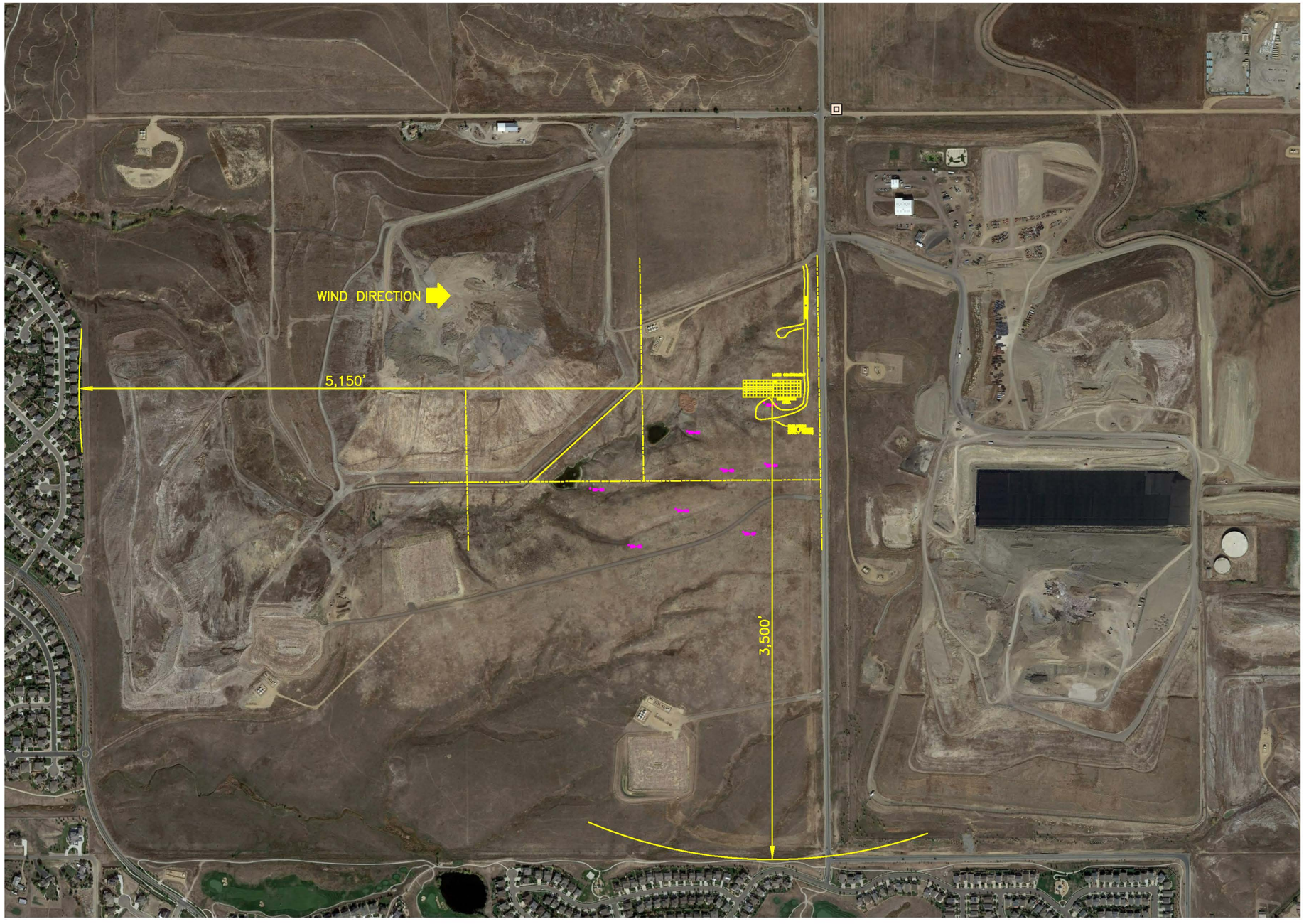
U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final. OSWER 9285.7-82. January 2009. Document (PDF) (68 pp, 724 K), memo (PDF) (3 pp, 487 K) and website.

U.S. EPA 2011. Exposure Factors Handbook 2011 Edition (Final). National Center for Environmental Assessment, Office of Research and Development. Washington D.C. Currently available online at http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252 or download here (PDF) (1436 pp, 21.3 MB).

U.S. EPA 2014. OSWER Directive 9200.1-120 (PDF) (7 pp, 1.1 MB). Washington, DC.

LIST OF FIGURES

Figure	Description
1	Site Vicinity Map
2	Air Monitoring Station Map
3	Perimeter Grid Map



0 800
FEET

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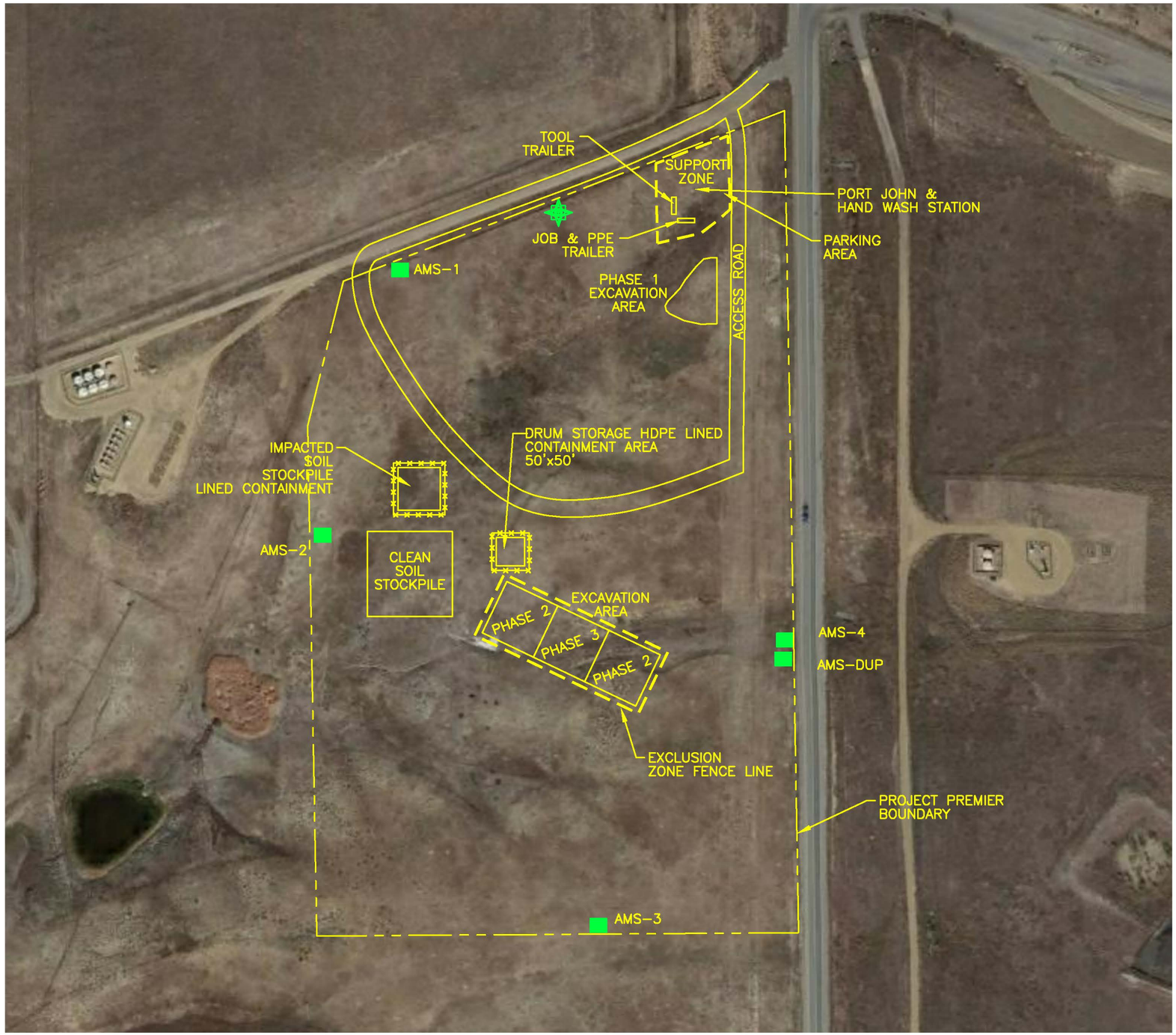
PSC

TITLE:
SITE VICINITY MAP
NEUHAUSER LANDFILL
2259 COUNTY ROAD 5 – ERIE, CO.

DWN: TMM	DES: JB	PROJECT NO: 62412010027 REDTAIL ERIE, CO
CHKD:	APPD:	
DATE: 11/13/17	REV:	FIGURE 1

COL 62412\010027A-003



LEGEND

AIR MONITORING STATION LOCATION

METEOROLOGICAL STATION

0 200
FEET

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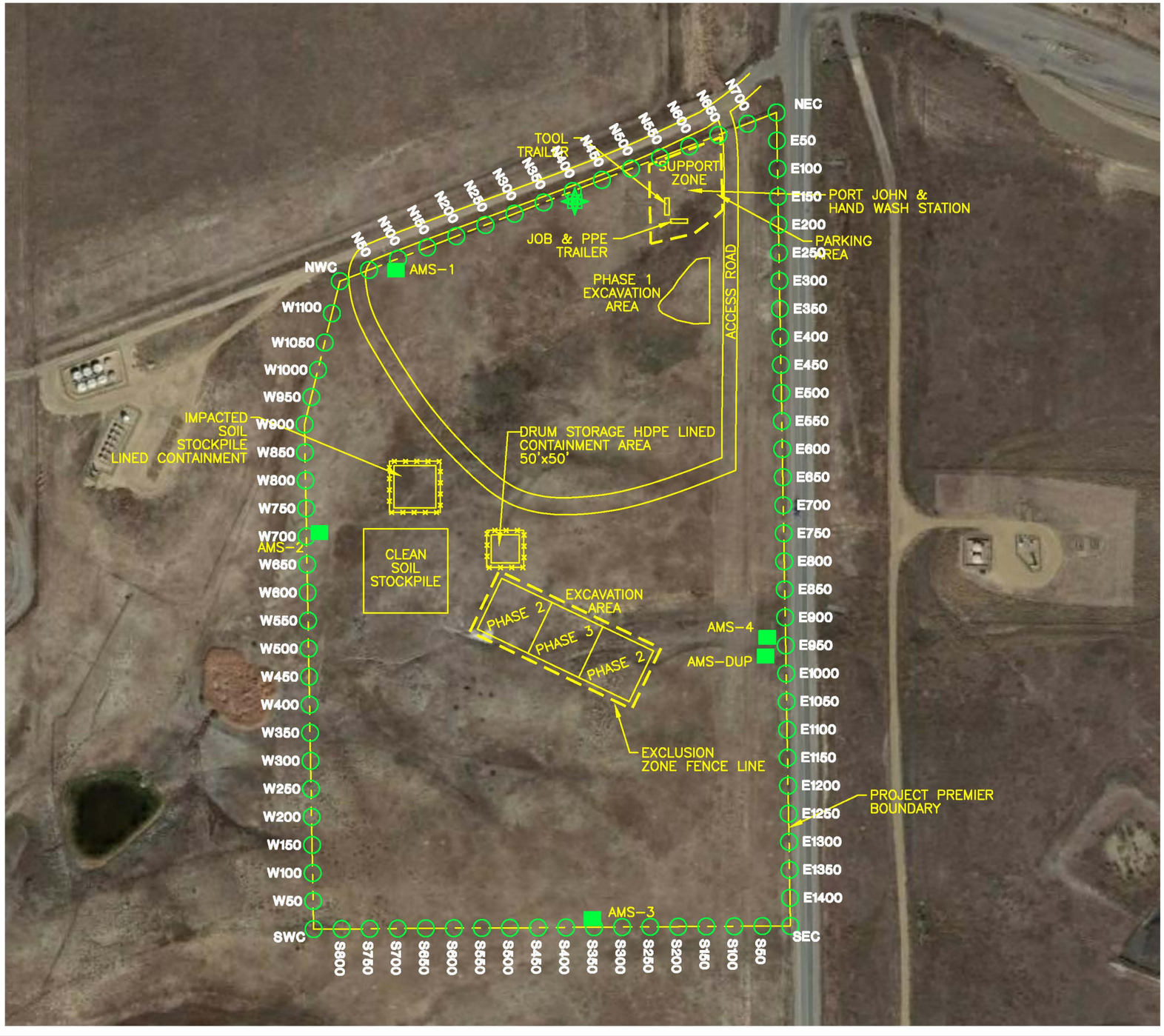
PSC

TITLE:
SITE LAYOUT MAP
NEUHAUSER LANDFILL
2259 COUNTY ROAD 5 – ERIE, CO.

DWN: TMM	DES: JB	PROJECT NO: 62412010027 REDTAIL ERIE, CO
CHKD:	APPD:	
DATE: 11/13/17	REV:	FIGURE 2

COL 62412\010027A-010



LEGEND

- AIR MONITORING STATION LOCATION
- METEOROLOGICAL STATION
- INTERMEDIATE PERIMETER MONITORING LOCATION (IPML)

0 200
FEET

N

PSC

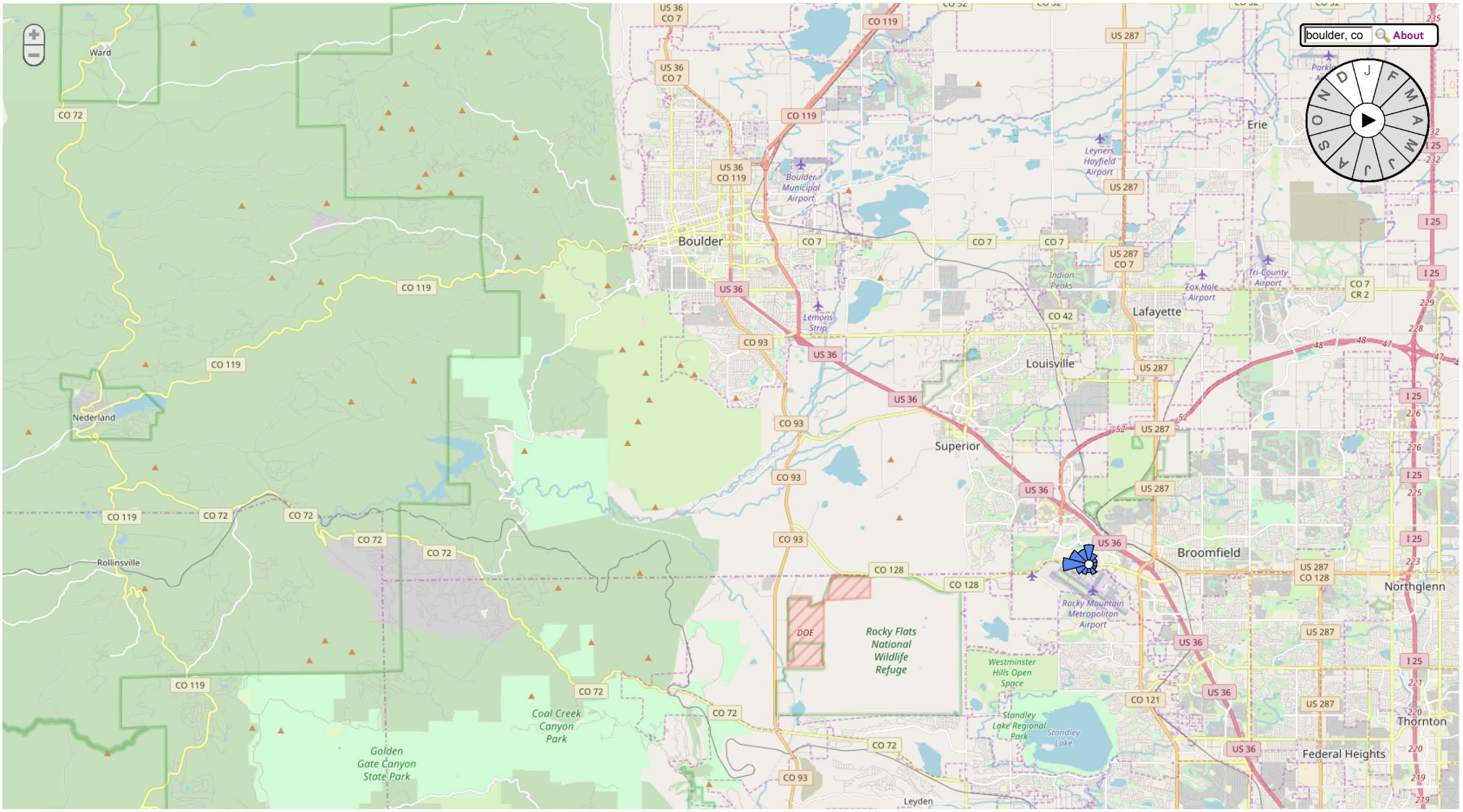
TITLE:
PERIMETER GRID MAP
NEUHAUSER LANDFILL
2259 COUNTY ROAD 5 – ERIE, CO.

DWN: TMM	DES: JB	PROJECT NO: 62412010027 REDTAIL ERIE, CO
CHKD:	APPD:	
DATE: 11/13/17	REV:	FIGURE 3

COL. 62412\010027A-011

APPENDIX A

HISTORICAL WEATHER WIND ROSE


boulder, co
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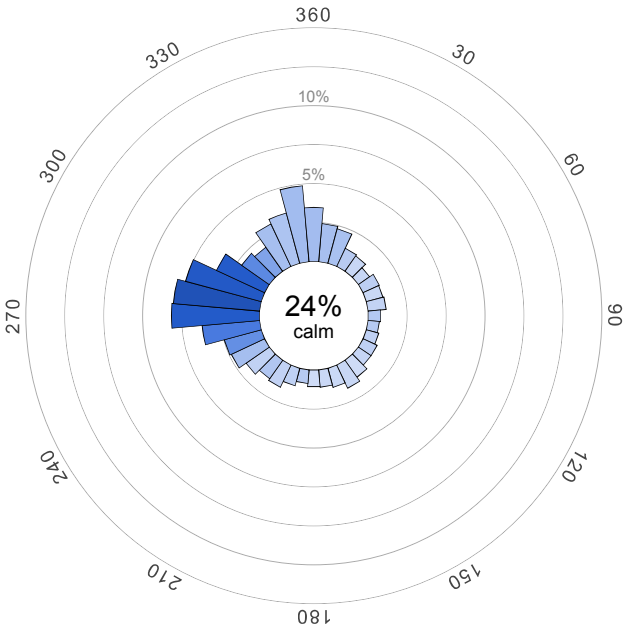
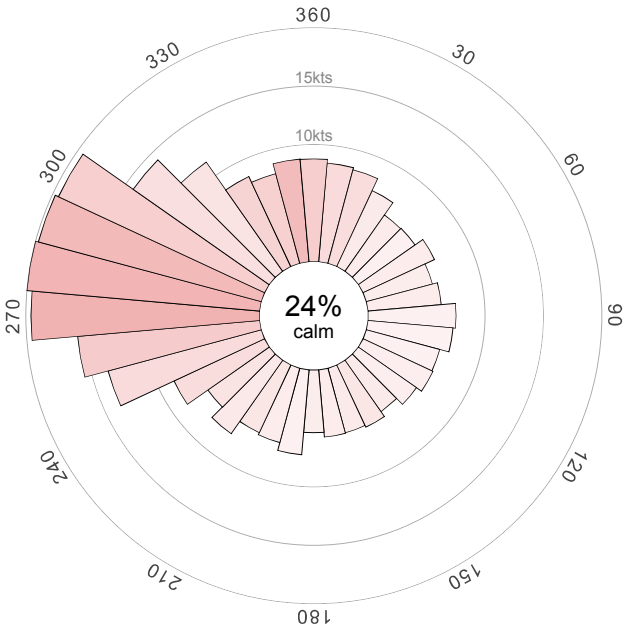
Rollinsville
Boulder
Erie
Lafayette
Louisville
Superior
Broomfield
Northglenn
Thornton
Federal Heights
Leyden
Boulder Municipal Airport
Leyners Hayfield Airport
Indian Peaks
Fox Hole Airport
Tri-County Airport
Lemons Strip
Rocky Mountain Metropolitan Airport
DOE
Rocky Flats National Wildlife Refuge
Westminster Hills Open Space
Standley Lake Regional Park
Standley Lake
Coal Creek Canyon Park
Golden Gate Canyon State Park
CO 72
CO 119
US 36
CO 7
CO 93
CO 128
CO 121
US 287
CO 42
CO 7 CR 2
I 25

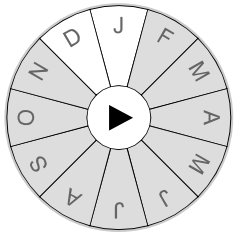
KBJC: Broomfield / Jeffco



Frequency by Direction



Average Speed by Direction



39.9167, -105.1167 WeatherSpark Wunderground VFRMap RunwayFinder NavMonster

A diagram of the prevailing winds at **KBJC**: Broomfield / Jeffco. The blue diagram at left is a wind rose: the bar length shows the frequency of winds from each direction. In the red diagram at right the bar length shows the average speed of winds when they come from that direction. For more information, see about this site.

Wind History. Copyright © 2011 Daedalus Bits, LLC. All rights reserved.

APPENDIX B

AIR MONITORING DOCUMENTATION FORMS

Daily Air Monitoring Activity Log

Project Name: Neuhauser Landfill

Page: 1 of 1

Site Location: 1831 Weld County Road 5, Erie, Colorado 80516

Date: 11 / xx / 2017

Project #: 624-1201-0027 - J0056

Field Air Crew:

Site Activity Log

Time	Activity

Note: This form is to document field activities on an hourly basis or as activities change.

Completed By: **Date:**

Daily Air Monitoring Weather Conditions Log

Project Name: Neuhauser Landfill

Page: 1 of 1

Site Location: 1831 Weld County Road 5, Erie, Colorado 80516

Date: 11 / xx / 2017

Project #: 624-1201-0027 - J0056

Field Air Crew: 0

Weather Conditions

Cloud Cover: S = Sunny (Clear); PC = Partly Cloudy; H = Hazy

Time	Temp. (°F)	Barometric Pressure (in. Hg)	Precipitation (check one)						Humidity (%)	Wind		Cloud Cover
			None	Rain	Drizzle	Fog	Sleet	Snow		Speed	Dir.*	

Note: * Wind Direction is the direction from which the wind is coming **from**.

Completed By:

Date: 1/00/1900

DAILY PERIMETER AIR MONITORING DATA FORM

Neuhauser Landfill Neuhauser Landfill

Page: 1 of 1

oad 5, Erie, Colorado 80516 1831 Weld County Road 5, Erie, Colorado 80516

Date: 11 / xx / 2017

624-1201-0027 - 624-1201-0027 - J0056

Air Field Techs.: 0 /

Site Activities:

☐ Excavating / Loading	☐ Decon	☐ Compacting
☐ Backfilling	☐ Installing/pulling slide rail	☐ Rock
☐ Water Treatment	☐ Hauling Clean Fill	☑ No Work
☐	☐ Pumping water from excavation	☐ Baseline Monitoring

Time - Clock Hour													
VOCs (ppm)	W10/AMS-1												
	W7												
	W4/AMS-2												
	N1/AMS-3												
	N4												
	E4/AMS-4												
	E7												
	E10												
	S4												

Notes / Comments:

VOCs Action Level:

Level One: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP

Level Two: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP

Level Three: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP

Level Four: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP

HOURLY PERIMETER AIR MONITORING DATA FORM

Project Name: Neuhauser Landfill

Page: 1 of 1

Site Location: 1831 Weld County Road 5, Erie, Colorado 80516

Air Technician:

Date: 11 / xx / 2017

Project Number: 624-1201-0027 - J0056

Air Technician:

Time:

Site Activities:

Fenceline Sample Location		1stPID (ppm)	2nd PID (ppm)	3rd PID (ppm)	
W10/AMS-1					
W7					
W4/AMS-2					
N1/AMS-3					
N4					
E4/AMS-4					
E7					
E10					
S4					

AMS #	Time	Summa (in.Hg.)		
1				
1D				
2				
3				
4				

Notes:

(1) The duplicate station AMS-1D is only used during every third sampling event.
(2) Samples for GC analysis are only collected when VOC concentrations exceed action levels.
N/A - Not applicable. The unit was not used at this time.

Atmospheric Conditions

WS _____ *Temp* _____ *RH* _____ *BP* _____ *Cloud Cover (S,PC,H,D):* _____

Predominant Wind Direction (from): _____

Cloud Cover: S = Sunny (Clear); PC = Partly Cloudy; H = Hazy; D = Dusty

Upwind Location: _____

Downwind Location: _____

Precipitation (Check Box)

None	Rain	Drizzle	Fog	Sleet	Snow

Notes/Comments:

Action Level(s): *(Document Exceedances Accordingly Below & Identify Location)*

Level One: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP -

Level Two: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP -

Level Three: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP -

Level Four: PID VOC Reading >2.0 ppm @ EZ, or >1.0 ppb @ PP -

-

EZ = Exclusion Zone; PP = Property Perimeter

TIME-INTEGRATED AIR MONITORING SAMPLE LOG

Project Name: *Neuhauser Landfill*
Site Location: *1831 Weld County Road 5, Erie, Colorado 80516*
Project #: 624-1201-0027 - J0056

Event #:
Start Date:
End Date:

Laboratory: Eurofins / Air Toxics (916) 985-1000
180 Blue Ravine Road, Suite B
Folsom, CA 95630-4719

Sampler(s):

TO-15 Volatiles			**Laboratory Calibrated Mass Flow Controller @ 72-Hour Flow Rate (LPM):**							
Sample ID			**Summa Cannister #**	**Flow Controller #**	**Leak Test Confirmed**	**Starting Pressure (-" Hg)**	**Ending Pressure (-" Hg)**	**Start Time (military)**	**End Time (military)**	**Total Time (in minutes)**
AMS 01 -	**010000**	- TO15								**00**
AMS 02 -	**010000**	- TO15								**00**
AMS 03 -	**010000**	- TO15								**00**
AMS 04 -	**010000**	- TO15								**00**
AMS 04D -	**010000**	- TO15								**00**
-	-	-		-	-	-	-	-	-	-

Air Toxics LTD.
180 Blue Ravine Road, Suite B
Folsom, CA 95630-4719
anc TEL: (916) 985-1000

AIR: CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1
PSC Event #: 0

Section A Required Client Information:		**Section B** Required Project Information:		**Section C** Invoice Information:	
Company:	**PSC Industrial Outsourcing, LP**	Report To:	**Jacob Blanton - PSC**	**Attention:**	**Jacob Blanton / Paul Anderson**
Address:	**210 West Sand Bank Road**	Copy To:	**Paul Anderson - PSC**	**Company Name:**	**PSC Industrial Outsourcing, LP**
	Columbia, IL 62236		Paul.Anderson@pscnow.com	**Address:**	**210 Wesst Sand Bank Road, Columbia, IL 62236**
Email To:	Paul.Anderson@pscnow.com	Purchase Order No.:		**Eurofins / Air Toxics Quote:**	**Q171125935R0 (Nov 14, 2017)**
Phone: (618) 281-1544 Fax:		Project:	**Neuhauser Landfill Site**	**Lab Project Mgr:**	**Ausha Scott**
Requested Due Date/TAT:	**STD TAT**	Project Number:	**624-1201-0027 - J0056**	**Lab Profile #:**	

Program: ☐ UST ☑ Superfund ☐ Emissions ☐ Clean Air Act ☐ Voluntary Clean Up ☐ Dry Clean ☐ RCRA ☐ Other_____

Location of Sampling by State: Colorado

Reporting Units
PM-10 (Total Grams)
TO-13 (Total µg)
TO-15 (µg/m3)

Report Level II.___ III.___ IV.__X__ Other_____

'Section D Required Client Information

Valid Media Codes

MEDIA	CODE
Sampling Bag	SB
1 Liter Summa Can	1LC
6 Liter Summa Can	6LC
Low Volume Puff	LVP
High Volume Puff	HVP
Other	PM10

ITEM #	AIR SAMPLE ID (Sample IDs MUST BE UNIQUE)	MEDIA CODE	PID Reading (Client only)	SAMPLE COLLECTION PERIOD COMPOSITE - START DATE	COMPOSITE - START TIME	COMPOSITE - END/GRAB DATE	COMPOSITE - END/GRAB TIME	Initial Field reading (inches of Hg)	Final Field reading (inches of Hg)	Filter PUF Summa Bar Code #	SUMMA Flow Controller Bar Code #	Method: TO-15 (VOCs)	Teklab ID
3	AMS 01 - 010000 - TO15	6LC		1/0/1900	12:00 AM	1/0/1900	12:00 AM	0	0	0	0	X	
6	AMS 02 - 010000 - TO15	6LC		1/0/1900	12:00 AM	1/0/1900	12:00 AM	0	0	0	0	X	
9	AMS 03 - 010000 - TO15	6LC		1/0/1900	12:00 AM	1/0/1900	12:00 AM	0	0	0	0	X	
12	AMS 04 - 010000 - TO15	6LC		1/0/1900	12:00 AM	1/0/1900	12:00 AM	0	0	0	0	X	
15	AMS 04D - 010000 - TO15	6LC		1/0/1900	12:00 AM	1/0/1900	12:00 AM	0	0	0	0	X	
18													

SAMPLER NAME AND SIGNATURE	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
PRINT Name of SAMPLER:	- PSC					
DATE Signed (M / DD / YYYY):						

SAMPLE CONDITIONS

Temp in °C	Received on Ice Y/N	Custody Sealed Cooler Y/N	Samples Intact Y/N
	Y/N	Y/N	Y/N

Comments:

APPENDIX C

LABORATORY CONSTITUENT AND REPORTING LIMIT LIST

TO-15 Reporting Limit Calculator

Compound	TO-15 CAS#	Base Reporting Limit ppbv	Base Reporting Limit µg/m3	Estimated Sample RL µg/m3
Freon 12	75-71-8	0.50	2.5	4.4
Freon 114	76-14-2	0.50	3.5	6.1
Chloromethane	74-87-3	5.0	10	17.5
Vinyl Chloride	75-01-4	0.50	1.3	2.3
1,3-Butadiene	106-99-0	0.50	1.1	1.9
Bromomethane	74-83-9	5.0	19	33.3
Chloroethane	75-00-3	2.0	5.3	9.3
Freon 11	75-69-4	0.50	2.8	4.9
Ethanol	64-17-5	2.0	3.8	6.7
Freon 113	76-13-1	0.50	3.8	6.7
1,1-Dichloroethene	75-35-4	0.50	2.0	3.5
Acetone	67-64-1	5.0	12	21.0
2-Propanol	67-63-0	2.0	4.9	8.6
Carbon Disulfide	75-15-0	2.0	6.2	10.9
3-Chloropropene	107-05-1	2.0	6.3	11.0
Methylene Chloride	75-09-2	5.0	17	29.8
Methyl tert-butyl ether	1634-04-4	0.50	1.8	3.2
trans-1,2-Dichloroethene	156-60-5	0.50	2.0	3.5
Hexane	110-54-3	0.50	1.8	3.2
1,1-Dichloroethane	75-34-3	0.50	2.0	3.5
2-Butanone (Methyl Ethyl Ketone)	78-93-3	2.0	5.9	10.3
cis-1,2-Dichloroethene	156-59-2	0.50	2.0	3.5
Tetrahydrofuran	109-99-9	0.50	1.5	2.6
Chloroform	67-66-3	0.50	2.4	4.2
1,1,1-Trichloroethane	71-55-6	0.50	2.7	4.7
Cyclohexane	110-82-7	0.50	1.7	3.0
Carbon Tetrachloride	56-23-5	0.50	3.1	5.4
2,2,4-Trimethylpentane	540-84-1	0.50	2.3	4.0
Benzene	71-43-2	0.50	1.6	2.8
1,2-Dichloroethane	107-06-2	0.50	2.0	3.5
Heptane	142-82-5	0.50	2.0	3.5
Trichloroethene	79-01-6	0.50	2.7	4.7
1,2-Dichloropropane	78-87-5	0.50	2.3	4.0
1,4-Dioxane	123-91-1	2.0	7.2	12.6
Bromodichloromethane	75-27-4	0.50	3.4	6.0
cis-1,3-Dichloropropene	10061-01-5	0.50	2.3	4.0
4-Methyl-2-pentanone	108-10-1	0.50	2.0	3.5
Toluene	108-88-3	0.50	1.9	3.3
trans-1,3-Dichloropropene	10061-02-6	0.50	2.3	4.0
1,1,2-Trichloroethane	79-00-5	0.50	2.7	4.7
Tetrachloroethene	127-18-4	0.50	3.4	6.0
2-Hexanone	591-78-6	2.0	8.2	14.4
Dibromochloromethane	124-48-1	0.50	4.2	7.4
1,2-Dibromoethane (EDB)	106-93-4	0.50	3.8	6.7
Chlorobenzene	108-90-7	0.50	2.3	4.0
Ethyl Benzene	100-41-4	0.50	2.2	3.9
m,p-Xylene	108-38-3	0.50	2.2	3.9
o-Xylene	95-47-6	0.50	2.2	3.9
Styrene	100-42-5	0.50	2.1	3.7
Bromoform	75-25-2	0.50	5.2	9.1
Cumene	98-82-8	0.50	2.4	4.2
1,1,2,2-Tetrachloroethane	79-34-5	0.50	3.4	6.0
Propylbenzene	103-65-1	0.50	2.4	4.2
4-Ethyltoluene	622-96-8	0.50	2.4	4.2
1,3,5-Trimethylbenzene	108-67-8	0.50	2.4	4.2
1,2,4-Trimethylbenzene	95-63-6	0.50	2.4	4.2
1,3-Dichlorobenzene	541-73-1	0.50	3.0	5.3
1,4-Dichlorobenzene	106-46-7	0.50	3.0	5.3
alpha-Chlorotoluene	100-44-7	0.50	2.6	4.6
1,2-Dichlorobenzene	95-50-1	0.50	3.0	5.3
1,2,4-Trichlorobenzene	120-82-1	2.0	15	26.3
Hexachlorobutadiene	87-68-3	2.0	21	36.8
Naphthalene (by request)	91-20-3	1.0	5.2	9.2
TPH- Gasoline (by request)	NA	50	204	357.0

Assume post-sample can vacuum of 7.0 in Hg and no analytical dilution. (*Typical post-sample vacuum for TWA sample ranges from 4 in Hg to 10 in Hg* .)

Select Can Size (L): 6 1.75

APPENDIX D

USEPA RESIDENT SCREENING LEVELS

Site-specific

Resident Equation Inputs for Air

Variable	Input Value	Notes
ED_{res} (exposure duration) years	0.083	30 work days, not years, no exposure once remediation completed
TR (target risk) unitless	0.000001	
THQ (target hazard quotient) unitless	0.1	used 0.1 since multiple constituents present
LT (lifetime) years	70	
EF_{res} (exposure frequency) days/year	30	30 days total
ED_{0-2} (mutagenic exposure duration first phase) years	0.083	30 days, not years
ED_{2-6} (mutagenic exposure duration second phase) years	0.083	"
ED_{6-16} (mutagenic exposure duration third phase) years	0.083	"
ED_{16-26} (mutagenic exposure duration fourth phase) years	0.083	"
EF_{0-2} (mutagenic exposure frequency first phase) days/year	30	30 work days, not years, no exposure once remediation completed
EF_{2-6} (mutagenic exposure frequency second phase) days/year	30	"
EF_{6-16} (mutagenic exposure frequency third phase) days/year	30	"
EF_{16-26} (mutagenic exposure frequency fourth phase) days/year	30	"
ET_{res} (exposure time) hours/day	24	8 hour work days, but exposure potential of 24 hours per day for off-site receptors
ET_{0-2} (mutagenic exposure time first phase) hours/day	24	"
ET_{2-6} (mutagenic exposure time second phase) hours/day	24	"
ET_{6-16} (mutagenic exposure time third phase) hours/day	24	"
ET_{16-26} (mutagenic exposure time fourth phase) hours/day	24	"

Output generated 15NOV2017:14:00:34

Site-specific

Resident Screening Levels (RSL) for Air

Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Chemical	CAS Number	Mutagen?	VOC?	Inhalation Unit Risk $(ug/m^3)^{-1}$	IUR Ref	RfC (mg/m^3)	RfC Ref	Carcinogenic SL TR=1.0E-6 (ug/m^3)	Noncarcinogenic SL THI=0.1 (ug/m^3)	Screening Level (ug/m^3)
Methyl Ethyl Ketone (MEK or 2-Butanone)	78-93-3	No	Yes	-		5.00E+00	U	-	6.08E+03	6,080 nc
Toluene	108-88-3	No	Yes	-		5.00E+00	U	-	6.08E+03	6,080 nc
Trichloroethylene (TCE)	79-01-6	Yes	Yes	4.10E-06	U	2.00E-03	U	5.10E+02	2.43E+00	2.43 nc

Output generated 15NOV2017:14:00:34

Site-specific

Resident Risk for Air

Chemical	Inhalation Unit Risk $(ug/m^3)^{-1}$	IUR Ref	RfC (mg/m^3)	RfC Ref	Concentration (ug/m^3)	Carcinogenic Risk	Noncarcinogenic HI
Methyl Ethyl Ketone (MEK or 2-Butanone)	-		5	U	-	-	-
Toluene	-		5	U	-	-	-
Trichloroethylene	0.0000041	U	0.002	U	-	-	-
**Total Risk/HI*	-		-		-	-	-

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Prepared for

Stratus Redtail Ranch, LLC

Neuhauser Landfill, Weld County, Colorado

Draft Field Sampling Plan

Drum Removal Work Plan

Prepared by

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December 2017

This Field Sampling Plan for the Drum Removal Work Plan at the Neuhauser Landfill Site, located in Weld County, Colorado has been prepared by Geosyntec Consultants and reviewed by the following:

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Figure 1 Site Location Map

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Appendix A Field Standard Operating Procedures

LIST OF ACRONYMS

AOC	Administrative Settlement Agreement and Order on Consent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Chemical of Potential Concern
CFR	Code of Federal Regulation
DQO	Data Quality Objective
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
Geosyntec	Geosyntec Consultants
GPS	Global Positioning System
ID	Identification
LPM	Laboratory Project Manager
mg/L	Milligrams Per Liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
OCP	Organochlorine Pesticides
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
VOC	Volatile Organic Compound

1. INTRODUCTION

1.1 Terms of Reference

This Field Sampling Plan (FSP) has been prepared as part of the Drum Removal Work Plan (DRWP) for the Neuhauser Landfill (Site) located in Erie, Colorado. The DRWP is required by an Administrative Settlement Agreement and Order on Consent Docket Number CERCLA-08-2018-0002 (AOC) entered into voluntarily by the United States Environmental Protection Agency (EPA) and Stratus for removing buried drums located at certain property more specifically described in Figure 1 located in Weld County, Colorado Site (the "Site").

This FSP is part of the Sampling and Analysis Plan (SAP), one of several DRWP planning Documents submitted concurrently in fulfillment of Section VIII (Work To Be Performed) of the AOC.

1.2 Site Location, Conditions, and History

Refer to the DRWP for details on the Site location, conditions, and history.

1.3 Sampling Objectives

The goals of the DRWP are the excavation and removal of buried drums identified at the Site during the July 2017 and subsequent geophysical investigations; overpacking of leaking drums as necessary to prevent further releases; sampling and characterization of drum contents for disposal purposes; safe storage of the drums pending laboratory results and disposal arrangements; transport and disposal of the drums at facilities in compliance with the CERCLA off-site disposal rule within 30 days of excavation; inventorying of drum contents and recording of excavation global positioning system (GPS) coordinates; and minimizing emissions of volatile organic compounds (VOCs) to the ambient air. This drum removal action also includes removal of soils contaminated by leaking drums, if any, and removal of a deposit of black sludge.

The objectives of this FSP are to:

- present the rationale for the number and types of characterization samples to be collected during the DRWP actions;

- describe the procedures to be used for collection, preservation, packaging, and transport of characterization samples;
- present documentation requirements for sample activities and sample custody; and,
- describe the procedures for characterization and decontamination of sampling equipment.

The FSP has been prepared primarily for use by field personnel to ensure sample collection and analytical activities are conducted in accordance with technically accepted protocols and that the data meet site-specific Data Quality Objectives (DQOs) established in the QAPP. Accordingly, the intent of this FSP is to provide the procedures required to implement the program outlined in the DRWP for the Site.

2. FIELD ACTIVITIES

2.1 Pre-Investigation Activities

Much of the DRWP activities will take place continuously over the course of several weeks. To reduce potential problems in the field, the following tasks, at a minimum, should be completed prior to conducting field activities:

- coordinate the project schedule and provide notification to EPA and CDPHE;
- contact the laboratory to review analytical requirements, provide sample containers, and discuss delivery and pickup of coolers and packages;
- coordinate with other contractors to review the scope of work, schedule field activities, and discuss special equipment needs;
- order field supplies and secure specialized equipment needed to complete field activities;
- provide copies of project documents to field personnel; and
- review the scope of work with the Project Manager to identify any potential problems.

2.1.1 Mobilization and Site Access

Mobilization, site setup and security are detailed in Section 4.3 of the DRWP.

2.1.2 Field Standard Operating Procedures

SOPs referenced in this document are listed below. The individual SOPs are included in Appendix A of the FSP.

SOP No.	Description
SOP No. 100	Drum Sampling
SOP No. 200	Soil / Sludge Sampling
SOP No. 500	Sample Shipping
SOP No. 600	Equipment Decontamination

2.2 Drum Waste

2.2.1 Introduction

This section of the FSP is referred to as drum waste sampling, because it may include a variety of containerized waste materials. Before sampling occurs, the buried drums will be exhumed and sorted based on container labels and physical characteristics. Composite samples will be collected from drums containing similar waste, with a maximum of five drums per composite sample. Alternately, one sample may be used to characterize more than one drum if the drum contents appear to be from a common source, based on the nature and source of contamination, drum labeling, and field screening information, as approved by the EPA OSC. Waste drums that contain unique waste that cannot be sorted will be individually sampled. The sampling regime is designed to provide representative samples to support characterization of the waste for off-site disposal at the appropriate (i.e. hazardous or non-hazardous materials) permitted facilities.

The analytical program for drum waste samples will be defined by the waste profile requirements of the EPA approved CERCLA offsite disposal facility, but may consist of the following:

- Volatile organic compounds (VOCs), semi-volatile organic compound (SVOC), organochlorine pesticides (OPCs), herbicides, total polychlorinated biphenyls (PCBs), the RCRA metals (arsenic, barium, cadmium, chromium; lead, mercury, selenium and silver) for liquid drum waste samples;

- Toxicity Characteristic Leaching Procedure (TCLP) for VOCs, SVOC, OPCs, herbicides, the RCRA metals for solid and sludge drum waste samples;

- Sulfide, cyanide, ignitability, and pH for all drum waste (liquid and solid) samples.

The actual analytical testing may be reduced where non-detect results are found for a set of compounds or a metal. Table 3 of the QAPP provides a detailed record of the required analyses for each sample.

2.2.2 Waste Sample Collection Procedures

2.2.2.1 Sampling Equipment

Drum waste samples may be collected using a stainless-steel trowel, bailer, drum thief, or a peristaltic pump. Required sampling equipment includes decontaminated stainless-steel bowls, spoons, buckets, peristaltic pump and tubing, and laboratory-supplied containers. A comprehensive equipment list is documented in SOP No. 100. Compositing tools and sampling equipment will be decontaminated between sampling locations. Decontamination procedures are described in Section 4.

2.2.2.2 Sample Collection

Drums will be segregated into groups of similar materials and composite samples from each of these groups will be collected. However, discrete samples for VOC analysis will be collected, unless a multi-increment sampling strategy is employed. Each group will consist of a maximum of five drums; for example, if a segregated group consists of 13 drums, 3 composite (or, in the case of VOCs, discrete) samples will be collected. Alternately, one sample may be used to characterize up to five drums when the drum contents appear to be from a common source, based on the nature and source of contamination, drum labeling, and field screening information, as approved by the EPA OSC. Drums that contain unique waste that cannot be grouped will be individually sampled. Details regarding drum waste sample collection will be recorded in the sample

sheets/field forms. These details will include sample location, date, and time. Section 3.1 describes in detail the documentation requirements for sampling activities. Procedures for drum sample collection are described in SOP No.100. Samples will be placed in laboratory-provided containers, held on ice, and shipped to the laboratory along with a completed Chain-of-Custody Record. Drum waste sampling analytical requirements are summarized in Table 3 of the QAPP.

2.2.2.3 Sample Containerization

Drum waste samples will be placed in appropriate laboratory-supplied containers and preserved in accordance with the analytical requirements listed in Table 4 of the QAPP.

2.2.3 Sample Handling and Analysis

Proper field sampling documentation and field analytical and laboratory documentation help to ensure sample authenticity and data integrity. Section 3.2 of this FSP describes the methods for assigning unique sample names. The unique sample name will be used on the sample containers and Chain-of-Custody Record. Drum waste samples will be placed in laboratory-provided containers, kept on ice, and shipped to the laboratory along with a completed Chain-of-Custody Record. Procedures for sample shipping are described in SOP No.500.

Drum waste samples will be analyzed using the following analytical methods for addressing waste disposal characterization:

Liquid drum samples:

- VOCs (EPA Method 8260C)
- SVOCs (EPA Method 8270D)
- OCPs (EPA Method 8081B)
- Herbicides (EPA Method 8151A)
- PCBs (EPA Method 8082A)
- Metals (EPA Method 6010C)

- Mercury (EPA Method 7471B)
- cyanide (EPA Method 9014)
- sulfide (EPA Methods 9031/9034)
- ignitability (EPA Method 1010A)
- pH (EPA Method 9045D)

Solid and sludge drum samples:

- TCLP VOCs (EPA Methods 1311/8260C)
- TCLP SVOCs (EPA Methods 1311/8270D)
- TCLP OCPs (EPA Methods 1311/8081B)
- TCLP Herbicides (EPA Methods 1311/8151A)
- TCLP metals (EPA Methods 1311/6010C)
- TCLP mercury (EPA Methods 1311/7470A)
- PCBs (EPA Method 8082A)
- cyanide (EPA Method 9014)
- sulfide (EPA Methods 9030B/9034)
- ignitability (EPA Method SW 846 7.1.2)
- pH (EPA Method 9045D)

The analyses required for waste samples are summarized in Table 3 of the QAPP. Laboratory services will be provided by TestAmerica (TA) Denver, Colorado and TA Pittsburgh, Pennsylvania. The QAPP provides SOPs for laboratory analyses (Appendix B).

2.3 Soil and Sludge Sampling

2.3.1 Introduction

Unless otherwise approved by the EPA OSC, the soil and sludge samples will be collected from the drummed or stockpiled soils and sludges. The analytical data will be compared to RCRA hazardous waste characteristics (40 CFR § 261) to support characterization of the waste for off-site disposal at the appropriate permitted facilities. The approximate number and location of samples to be collected is based on preliminary field observations.

The analytical program will consist of the following:

- TCLP or Total analyses for VOCs, SVOC, OPCs, herbicides, and the RCRA metals; and
- Total PCBs, sulfide, cyanide, ignitability, and pH.

Table 3 of the QAPP provides a detailed record of the required analyses for each sample.

2.3.2 Soil Sample Collection Procedures

2.3.2.1 Sampling Equipment

Soil samples will be collected using a stainless steel hand auger or stainless steel trowel. Required sampling equipment includes decontaminated stainless steel bowls and spoons, and laboratory-supplied containers. A comprehensive equipment list is documented in SOP No. 200. Tools and sampling equipment will be decontaminated between sampling locations. Decontamination procedures are described in Section 4 and SOP No. 600.

2.3.2.2 Sample Collection

Soil that is visibly contaminated by leaking drum or container contents, soil with a strong odor consistent with drum or container contents, soil with total VOC concentrations of 100 parts per million by volume (ppmv) or greater as determined by soil sample head-space screening using a photoionization detector (PID) and any sludge will be drummed before sample collection. Drummed soil will be segregated into groups of similar materials and composite samples from each of these groups will be collected. However, discrete samples for VOC analysis will be collected, unless a multi-increment sampling

strategy is employed. Each group will consist of a maximum of five drums; for example, if a segregated group consists of 13 drums, 3 composite (or, in the case of VOCs, discrete) samples will be collected. Alternately, one sample may be used to characterize up to five drums when the drum contents appear to be from a common source, based on the nature and source of contamination, drum labeling, and field screening information, as approved by the EPA OSC.

Soil that does not exhibit meet the criteria for being drummed will be excavated and stockpiled on site. One, five-point composite sample will be collected for every 50 cubic yards of excavated soil for waste profile characterization. However, discrete samples for VOC analysis will be collected, unless a multi-increment sampling strategy is employed. Details regarding soil sample collection will be recorded in the sample sheets/field forms. These details will include sample location, date, and time. Section 3.1 describes in detail the documentation requirements for sampling activities. Procedures for soil sample collection are described in SOP No. 200. Samples will be placed in laboratory-provided containers, held on ice, and shipped to the laboratory along with a completed Chain-of-Custody Record. Soil sampling analytical requirements are summarized in Table 3 of the QAPP.

2.3.2.3 Sample Containerization

Soil samples will be placed in appropriate laboratory-supplied containers and preserved in accordance with the analytical requirements listed in Table 4 of the QAPP.

2.3.3 Sample Handling and Analysis

Proper field sampling documentation and field analytical and laboratory documentation help to ensure sample authenticity and data integrity. Section 3.2 of this FSP describes the methods for assigning unique sample names. The unique sample name will be used on the sample containers and Chain-of-Custody Record. Soil samples will be placed in laboratory-provided containers, kept on ice, and shipped to the laboratory along with a completed Chain-of-Custody Record. Procedures for sample shipping are described in SOP No. 500.

Soil / sludge samples will be analyzed for TCLP or Total VOCs (EPA Method 1311/8260C), TCLP or Total SVOCs (EPA Method 1311/8270D), TCLP or Total OCPs (EPA Method 1311/8081B), TCLP or Total Herbicides (EPA Method 1311/8151A)

TCLP or Total metals (EPA Method 1311/6010C), TCLP or Total mercury (EPA Method 1311/7470A), total PCBs (EPA Method 8082A), cyanide (EPA Method 9014), sulfide (EPA Method 9030B/9034), ignitability (EPA Method SW 846 7.1.2), pH (EPA Method 9045D). The results of total samples will be compared to 20X groundwater quality criteria as an option to the TCLP testing.

The analyses required for soil/sludge samples are summarized in Table 3 of the QAPP. Laboratory services will be provided by TA Denver, Colorado and TA Pittsburgh, Pennsylvania. The QAPP provides SOPs for laboratory analyses.

2.4 Confirmation Soil Sampling

2.4.1 Introduction

Once buried drums and soils have been excavated according to Sections 4.4.2.1 and 4.4.2.2 of the DRWP, confirmation samples will be collect from the sidewalls and floor of the excavation area(s) to verify that the project goal has been achieved to remove highly contaminated soils that could pose an ongoing source of release of hazardous substances to groundwater.

The analytical program will consist of the following:

- TCLP VOCs, SVOC, OPCs, herbicides, and the RCRA metals; and
- Sulfide, cyanide, ignitability, and pH.

2.4.2 Confirmation Soil Sample Collection Procedures

2.4.2.1 Sampling Equipment

Soil samples will be collected using a stainless-steel hand auger or stainless steel trowel. Required sampling equipment includes decontaminated stainless-steel bowls and spoons, and laboratory-supplied containers. A comprehensive equipment list is documented in SOP No. 200. Tools and sampling equipment will be decontaminated between sampling locations. Decontamination procedures are described in Section 4 and SOP No. 600.

2.4.2.2 Sample Collection

Four confirmations will be taken from each sidewall of the excavation area for the first 100 linear feet of each side wall and one additional confirmation sample will be collected for each addition 250 linear feet of side wall length. One confirmation sample will be collected from the floor of the excavation area per every 2500 square feet of excavation area. Details regarding confirmation soil sample collection will be recorded in the sample sheets/field forms. These details will include sample location, date, and time. Section 3.1 describes in detail the documentation requirements for sampling activities. Procedures for soil confirmation sample collection are described in SOP No. 200. Samples will be placed in laboratory-provided containers, held on ice, and shipped to the laboratory along with a completed Chain-of-Custody Record. Soil confirmation sampling analytical requirements are summarized in Table 3 of the QAPP.

2.4.2.3 Sample Containerization

Soil characterization samples will be placed in appropriate laboratory-supplied containers and preserved in accordance with the analytical requirements listed in Table 4 of the QAPP.

2.4.3 Sample Handling and Analysis

Proper field sampling documentation and field analytical and laboratory documentation help to ensure sample authenticity and data integrity. Section 3.2 of this FSP describes the methods for assigning unique sample names. The unique sample name will be used on the sample containers and Chain-of-Custody Record. Soil samples will be placed in laboratory-provided containers, kept on ice, and shipped to the laboratory along with a completed Chain-of-Custody Record. Procedures for sample shipping are described in SOP No. 600.

Soil confirmation samples will be analyzed for TCLP or Total VOCs (EPA Method 1311/8260C), TCLP or Total SVOCs (EPA Method 1311/8270D), TCLP or Total OCPs (EPA Method 1311/8081B), TCLP or Total Herbicides (EPA Method 1311/8151A) TCLP or Total metals (EPA Method 1311/6010C), TCLP or Total mercury (EPA Method 1311/7470A), cyanide (EPA Method 9014), sulfide (EPA Method 9030B/9034), ignitability (EPA Method SW 846 7.1.2), pH (EPA Method 9045D).

Laboratory services will be provided by TA Denver, Colorado and TA Pittsburgh, Pennsylvania and potentially other qualified laboratories. The QAPP provides SOPs for laboratory analyses.

2.5 Field Quality Control Samples

Quality Control (QC) samples are typically collected in the field and submitted to the laboratory along with other environmental samples to evaluate field and laboratory precision and accuracy. Evaluation of field QC sample results allows for the quality of the data to be assessed as part of the overall project QA. The three types of field QC samples that will be used during sample collection are as follows:

- trip blanks;
- equipment rinsate blanks;
- field duplicates; and
- matrix spike/matrix spike duplicates (MS/MSDs).

Trip blank and equipment rinsate blank samples are used to assess field conditions during sample transport and collection. Field duplicates are replicate samples used to help assess sample collection and handling precision and MS/MSD samples are replicate samples used to help assess laboratory precision and accuracy in a specific site matrix. Section 3.2 of this FSP describes the methods for assigning unique sample names. The unique sample name will be used on the sample containers and Chain-of-Custody Record. Samples will be placed in laboratory-supplied containers and preserved in accordance with the analytical requirements summarized in Table 4 of the QAPP. One temperature blank will also be included with every shipping container from the laboratory to ensure that the samples arrive at acceptable temperatures.

The required frequency of field QC samples is summarized in Table 5 of the QAPP.

2.5.1 Trip Blanks

Trip blanks are filled with analyte free reagent grade water at the laboratory, shipped to the Site with the empty sample containers, and returned to the laboratory with the filled

sample containers. Trip blanks are used to determine if VOC samples have been cross-contaminated during shipping and handling.

Trip blanks will be included with each shipping container that contains waste, soil or liquid/aqueous waste samples to be analyzed for VOCs.

2.5.2 Equipment Rinsate Blanks

Equipment rinsate blanks will be collected following decontamination of sampling equipment (e.g., bowls, spoons, hand augers, knives). One equipment rinsate sample will be collected for every 20 samples submitted to the laboratory with a minimum of one equipment rinsate sample collected per sampling crew per day. Following decontamination of the equipment, deionized water will be poured over selected sampling equipment and collected for laboratory analysis. The equipment rinsate samples will be analyzed using the same methods used for field samples that day.

2.5.3 Matrix Spike/Matrix Spike Duplicate Samples

MS/MSD samples are replicate samples that are spiked with a known concentration of COPCs which are then measured as they would be for field samples; the results are used to determine precision and accuracy. One MS/MSD sample will be collected for every 20 investigative samples submitted for laboratory analysis. Only soil samples will require MS/MSD samples for this sampling event. The volume of sample collected at each of the locations where MS/MSD samples will be obtained is triple the routine volume: the first aliquot serves as the field sample, the second aliquot as the MS, and the third as the MSD.

3. DOCUMENTATION, SAMPLE PACKING, AND SHIPPING

3.1 Field Documentation

Field visits and sample collection programs are documented using a combination of field log books and specific field log forms. These two methods have their advantages and disadvantages, as follows:

- Field log books have the advantage of maintaining work chronology. Since pages and lines are used in sequence without any skips, it is possible to reconstruct the sequence of work in the event that any quality issues or other incidents arise. One log book can be used to document several weeks' worth of work in sequence

depending upon the nature of the work. In addition, since log books lack structure, they provide flexibility in that they can be used to document nearly any site work; however, the lack of structure in log books is a disadvantage for record-intensive work, such as groundwater sampling, because the lack of entry boxes for field parameters discourages consistent data collection.

- Conversely, field forms have the advantage of customization (e.g., a groundwater sampling form can be designed in detail to remind the field team member to record a list of specific readings). Field forms are valuable for large sampling events in which consistency in the method of recording observations is desired. They have the disadvantage of lacking weatherproofing or any degree of chronological sequence. They are also not as portable or durable as log books.

A log book will be in use for visits to the Site, ranging from brief site walks to major, multi-week characterization programs. If the work is short in duration (e.g., less than one day) and irregular or *ad hoc* in nature (i.e., a task that is not captured by a standard field form), then the work shall be documented in the log book. Conversely, if the site visit is longer in duration and more repetitive (e.g., a major groundwater or solid sampling event), corresponding field forms will be used for documentation of each sample, whereas the log book will be used to document a summary of the day's activities and non-repetitive tasks, including the following:

- time of arrival and departure from the Site, including lunch breaks;
- names of field team members;
- time of arrival and departure of subcontractors;
- the nature of the daily health and safety tailgate meeting, with signatures of participants;
- instrument calibration;
- supply deliveries;
- weather;
- interaction with agency or client personnel;

- incident occurrence and management; and
- any other irregular or *ad hoc* activities.

As such, the log book(s) will provide a comprehensive overview of site activities throughout the DRWP; the level of detail of documentation within each log book entry will depend upon the duration of an individual visit and the applicability of field forms to the tasks performed.

3.1.1 Details of Log Book Use

Sampling personnel will use a bound field log book with moisture-resistant pages to record pertinent field information with waterproof ink. The log book will identify the project name, project number, and geographic location of the site; it will also indicate the name and mobile telephone number of the Field Manager in the event that the log book is lost and recovered. Daily field activities and sampling information will be entered in the log book on serially-numbered pages. At the end of each day's entries, sample collection personnel shall sign and date the entry. Corrections will be made to entries with initialed and dated line-out deletions. A diagonal line will be drawn across the remaining blank space of the last page of each day's entry. Log book lines will be used in sequence, and no blank lines shall remain at the end of the day. Observations will be recorded in sequence.

Multiple log books may be required over the course of the DRWP. It is desirable to have a continuous sequence of log books throughout the course of the project, with one log book in use at any one time. Upon completion of a log book, the timeframe covered will be clearly indicated on the front cover and spine by noting the date range of work and investigative phase name. In some cases, however, the presence of multiple field teams may require the use of two log books in parallel. In these cases, the Field Manager shall maintain the primary log book. The secondary log book shall be clearly identified as such and shall make reference to the primary log book on or inside its front cover. It shall only be used to record observations made away from the Field Manager.

3.1.2 Field Forms

As discussed in Section 3.1, field forms shall be used for specific field sampling tasks of a routine and repetitive nature, such as waste sampling and soil sampling. Field forms

have the advantage of prompting the user for detailed data documentation in a consistent format.

Attachment C includes the following field form templates for various field tasks to be conducted during the DRWP:

- Daily Field Report;
- Drum Waste Sampling Record;
- Soil / Sludge Sampling Record.

The protocol for form completion will be similar to those of log books:

- requested information on the form will be completed unless not applicable. Blank spaces will be lined through our completed with an NA for not applicable;
- corrections shall be made through single-line strikeout with initials and date; and
- tables within forms (e.g., field parameters during well purging) shall be filled out with each line in sequence; no lines will be skipped, and unused lines at the end of sample collection shall be crossed out, initialed, and dated.

3.2 Sample Nomenclature

3.2.1 Field Sample Nomenclature

The sample identification scheme for field sample collection will utilize a three-letter project identification code followed by a sample type code, location code, and depth or date details. The general form is as follows:

NLF-aa-bbbbb-cccccMMDDYY, where identification components are described below.

“aa” is the matrix code or sample type code, which will correspond to the sample type as follows:

- LW: Liquid waste samples;
- SS: Soil samples;

- SW: Solid waste samples ; and
- SL: Sludge samples;

“bbbbb” is the group code, which will follow the sample type code and will consist of up to five characters that indicate the sample group or location. Hyphens will be omitted.

- DG1 Drum Group 1;
- DINV1 Individual Drum 1;
- CMPD1 Composite Sample from Drum Area 1; and
- CONF1 Confirmation Sample from Drum Area 1.

“ccccc” is the sample count for the sample group or location.

- COMP1 Composite Sample Number 1;
- ESW1 East Sidewall Sample Number 1
- FS1 Floor Sample Number 1

MMDDYY is the six digit abbreviation of the sample date

- 120117 December 1, 2017

Examples of sample identification numbers include:

- ELF-LW-DG1-COMP1-120117, for Neuhauser Landfill, liquid waste sample from drum group 1, first composite sample from drum group 1, collected on December 1, 2017;
- ELF-SS-CMPD1-COMP1-120117, for Neuhauser Landfill, soil sample, composite sample from drum area 1, first composite sample from drum area 1, collected on December 1, 2017; and,

- ELF-SS-CONF1-ESW1-120117, for Neuhauser Landfill, soil sample, confirmation sample from drum area 1, east side wall confirmation sample 1, collected on December 1, 2017.

3.2.2 Quality Control Sample Nomenclature

Field QC samples, will use the following nomenclature. If multiple QC samples are collected on a given day, append A, B, C, etc. in sequence to the sample name.

The naming convention is as follows:

- for equipment blanks, use EQ and the date;
- for trip blanks, use TB and the date; and
- for MS/MSDs, use and the unique sample ID and append MS and MSD as the suffix.

3.3 Sample Packing and Shipping – Field Procedures

3.3.1 Hold Times

The first step in proper sample handling and custody is observance of analytical holding times, which can vary from 24 hours to 180 days depending upon the analytical method(s) selected for the samples. Knowledge of required holding times will have a direct impact on scheduling of sample collection, packing, and shipping activities. The sample container, volume, preservation, and holding times applicable to each analytical method are shown in Table 4 of the QAPP.

3.3.2 Sample Custody

Sample collection and sample custody procedures are designed so that field custody of samples is maintained and documented. These procedures provide identification and documentation of the sampling event and the sample chain-of-custody from shipment of sample bottleware, through sample collection, to receipt of the sample by the subcontracted laboratory. When used in conjunction with the laboratory's custody procedures and the sample bottleware documentation, these data establish full legal custody and allow complete tracking of a sample from preparation and receipt of sample

bottleware to sample collection, preservation, and shipping through laboratory receipt, sample analysis, and data validation. The chain-of-custody is defined as the sequence of persons who have the item in custody.

Field custody procedures are described below. Sample collection procedures concerning sample identification and documentation, field log book, sample containers, sample packing, and sample shipping are described.

The persons responsible for sample custody, and a brief description of their duties, are as follows:

- **Laboratory Sample Custodian or Commercial Supplier:** Verifies that the bottleware is certified clean; arranges for bottleware shipment to field sampling personnel or the contractor's equipment shop.

- **Field Staff:** Receives sample bottleware from laboratory, inspects bottleware for physical integrity; retains shipping invoice or packing list from shipping courier as documentation of transfer of bottleware; collects and preserves samples; retains bottleware and samples under custody until sample shipment; relinquishes samples to shipping courier or to lab representative.

- **Laboratory Project Manager (LPM):** Verifies reported laboratory analyses to the sample Chain-of-Custody Record; assures that chain-of-custody documentation is incorporated into the project file.

A sample or other physical evidence is in custody if it is:

- in the field investigator's, transferee's, or lab technician's actual possession; or

- in the field investigator's, transferee's, or lab technician's view, after being in his/her physical possession; or

- in the field investigator's, transferee's, or lab technician's physical possession and then he/she secured it to prevent tampering; or

- placed in a designated secure area.

3.3.3 Chain-of-Custody Record

The field Chain-of-Custody Record is used to record the custody of samples or other physical evidence collected and maintained. This form shall not be used to document the collection of split or duplicate samples. The Chain-of-Custody Record also serves as a sample logging mechanism for the analytical laboratories' sample custodian.

The following information must be supplied in the indicated spaces in detail to complete the field Chain-of-Custody Record:

- project-specific information, including the project number and project name;
- signatures of samplers and/or the sampling team leader in the designated signature block;
- sampling station number, date, and time of sample collection, grab or composite sample designation, and sample preservation type included on each line (each line shall contain only those samples collected at a specific location);
- sampling team leader's name recorded in the right or left margin of the Chain-of-Custody Record when samples collected by more than one sampling team are included on the same form;
- total number of sample containers listed in the indicated space for each sample and the total number of individual containers for each type of analysis under the indicated media or miscellaneous columns (note that it is impossible to have more than one media type per sample);
- documentation of the transfer of samples listed on the Chain-of-Custody Record by the field investigator and subsequent transferee(s) in the spaces provided at the bottom of the form (both the person relinquishing the samples and the person receiving them must sign the form; provide the date and time that this occurred in the proper space on the form; and usually, the last person receiving the samples or evidence should be a laboratory sample custodian); and
- air bill numbers or registered or certified mail serial numbers recorded in the remarks column at the bottom of the form.

The Chain-of-Custody Record is a serialized document. Once the Chain-of-Custody Record is completed, it becomes an accountable document and must be maintained in the project file. The suitability of any other form for chain-of-custody should be evaluated upon its inclusion of the above information in a legible format. Examples of Chain-of-Custody Records for each laboratory described in this document are provided as Attachment A.

3.3.4 Sample Packing and Shipping

Samples are packed for shipping in waterproof ice chests and coolers. Depending upon container type, the sample containers may be individually sealed in Ziploc® or other similar plastic bags, prior to packing them in the cooler with bubble wrap or Styrofoam packing. Wet ice will be double-bagged in plastic bags (to inhibit cross contamination of samples by melt water) and placed with the samples in the cooler to maintain the samples at a temperature of 0≤6 2 degrees Celsius (°C) during shipping.

The Chain-of-Custody Record that identifies the samples is signed as "relinquished" by the principal sampler or responsible party. This Chain-of-Custody Record is sealed in a waterproof plastic bag and is placed inside the cooler, typically by taping the bag to the inside lid of the cooler.

Following packing, the cooler lid is sealed with packing tape. A custody seal is signed, dated, and affixed from the cooler lid to the cooler body, and is additionally covered with clear tape. This ensures that tampering with the cooler contents will be immediately evident.

The sample coolers are typically shipped by overnight express courier to the laboratory. A copy of the shipping invoice is retained by the Field Manager and becomes part of the sample custody documentation.

4. DECONTAMINATION

4.1 Standard Procedures

Decontamination of equipment and tools will be conducted in a centralized area to improve management of decontamination liquids. Equipment used for sampling will be decontaminated prior to each use and in general accordance with the cleaning procedures presented in Section 4 and SOP No.600.

A decontamination area for sample preparation equipment will be established within or near the boundary of the Exclusion Zone (EZ). The EZ is defined as the area where contamination is either known or likely to be present, or because of activity, will potentially harm personnel. Entry into the EZ requires the use of personal protective equipment (PPE).

A personnel decontamination station will be established outside and adjacent to the EZ. Personnel will proceed through the appropriate contamination reduction sequence upon leaving the EZ. PPE will be left on-site during any breaks after performing decontamination procedures.

4.2 Sampling Equipment Decontamination Procedures

The following steps outline the decontamination protocol for sampling equipment:

- tap water wash with non-phosphate soap (e.g., Alconox);
- tap water rinse;
- 10% nitric acid rinse:
- distilled water rinse;
- deionized water rinse;
- air dry; and
- aluminum foil wrap.

Decontaminated sampling equipment does not have to be wrapped in aluminum foil if the sampling equipment is to be reused the same day as per Section 2.3, Step 12 of SOP No. 600.

Clean, disposable gloves will be worn while handling sampling equipment or downhole tools during the final stages of decontamination. Deionized water will be stored in high-density polyethylene (HDPE) containers and applied via HDPE squeeze bottles or decanted directly from their storage containers.

4.3 Persistent Contamination

In some instances, equipment will become contaminated with substances that cannot be removed by normal decontamination procedures. A strong detergent (e.g., Alconox or other industrial grade detergent) may be used to remove such contamination from equipment if it does not destroy or degrade the equipment.

4.4 Disposal of Contaminated Materials

Disposable and single-use materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and other equipment that is contaminated must be secured in drums or other containers and labeled. See Section 5 for details.

5. MANAGEMENT OF INVESTIGATION-DERIVED WASTES (IDW)

Solid and liquid waste will be tested for the RCRA TCLP parameters and those data will be used to support IDW waste profiling followed by disposal to permitted facility, as needed.

5.1 Identification of Investigation-Derived Waste Streams

Two sources of IDW have been identified for the Site:

- decontamination wastes from waste fluids generated during decontamination of field equipment, sampling equipment, and PPE; and
- PPE from disposable items (e.g., gloves, Tyvek® suits, etc.) used to implement the health and safety program.

5.2 Decontamination Wastes

Wastes associated with the decontamination of field equipment will consist primarily of liquids, with minor amounts of solids. The wastes will be generated by the cleaning of:

- sampling equipment;
- heavy equipment (e.g. bulldozer, backhoe); and
- personnel exiting the exclusion zone around each sampling location.

Following generation, decontamination water will be placed in a bulk storage container. The decontamination water will be decanted during transfer to the bulk storage container to minimize the amount of solids transferred. Solids present after decanting will be placed in drums and treated as containerized waste. The decontamination water will be disposed of at an off-site treatment facility.

5.3 Personal Protective Equipment

Waste PPE will be generated during DRWP activities Spent PPE and disposable sampling equipment will be placed in trash bags and secured inside the building at the Site for future disposal with other non-hazardous wastes.

6. SCHEDULE

A schedule for sampling tasks is discussed in the DRWP.

FIGURES

Stratus Redtail Ranch
2259 County Road 5, Erie, CO

Site Map

	Figure 1	12/4/2017
	DE0302	**DRAFT**

Document Path: E:\DRH_work\GIS\DE0302_stratus\2017\201712\mxd\fig1_site_map_poster.mxd

APPENDIX A

FIELD STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE NO. 100

DRUM SAMPLING

Prepared by:____Chris Pracheil_____ Date: ____07 Nov. 2017_

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

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STANDARD OPERATING PROCEDURE NO. 019

DRUM SAMPLING

1.0 INTRODUCTION

Sampling of drums shall be conducted to characterize the contents for off-site disposal. While this SOP applies in general to any drums encountered during the DRWP, the only drums anticipated to be handled are those buried in the Buried Drum Area 1 (BDA 1) and Buried Drum Area 2 (BDA 2) identified in Figure 1 of the DRWP.

The following equipment and supplies may be used during drum sampling:

- field logbook;
- Photoionization Ionization Detector (PID);
- non-sparking drum wrench;
- non-sparking mallet and chisel;
- remotely operated non-sparking punch or other device to open drums suspected of having a volatile or reactive nature;
- stainless steel hand probe, spoon, or spatula (for solids samples);
- syringe for VOC samples;
- stainless steel bowl;
- glass thieving tubes or bailers;
- sample containers;
- decontamination supplies; and
- digital camera.

Sampling of drums with known and unknown contents may be required during field investigations. The sampling procedure for each circumstance will be the same; however, the preliminary drum identification and opening procedures will differ, as may the required PPE. The drum sampling procedures listed below shall be conducted

only within the temporary drum staging area which will be designed as part of the Drum Removal Plan.

2.0 DRUMS WITH KNOWN CONTENTS

When sampling a drum of known contents, the following drum opening and sampling procedures shall be in accordance with the Contractors SOPs, though should include the following

1. Accurately and completely fill out the attached drum inventory log during assessment and sampling of the drum. The drum identification number on the log will key the drum inventory database to the chain of custody, and therefore, to the drum sample database.

2. Photograph the drum to document its condition and any labels or markings. Additionally, note details of markings on the drum log in case photographs are not sufficiently legible.

3. Before opening the drum, segregate the drum as liquid or solid or unstable/reactive, if known and if the drum can be moved without threat of a rupture (see “Drums With Unknown Contents" below).

4. Before opening the drum, ground it electrically to avoid sparking.

5. Loosen the cover or bung of the drum and scan the drum headspace with a PID . If opening the cover, only crack the cover and place the tip of the instrument inside the drum. Record the measurements on the drum log.

6. If PID , support the level of PPE used, remove the drum cover and record the measurements on the drum log.

7. Material from the drum shall be collected using a stainless steel hand probe or a stainless steel spoon (for solids) or a disposable bailer (for liquids). Collection of a hand probe sample is the preferred collection method for drummed solids.

8. For a liquid sample, place the tube or bailer into the center of the drum to collect the sample. Withdraw the sampler, and pour liquids directly into the appropriate sample containers. Seal and label containers. If additional volume is required, repeat the process. Return unused liquid to the drum.

9. For a solids sample, advance the hand probe into the center of the drum to collect the core. Collection of the drum core should be from the 0.5 to 2.5 foot interval below the surface of the material. Withdraw the sampling device from the drum.

10. Gently remove solids from the hand probe, and screen for VOCs (using a PID). Record the measurements in a field log.

11. Select the portion of the drum core with the highest PID reading for VOC analysis (if required), and place in the appropriate sample container. Seal and label sample container.

12. Mix the remaining sample thoroughly using a clean stainless steel bowl and spoon. Fill the remaining sample containers, then seal and label the containers.

13. If additional volume is needed to fill the required sample containers, repeat steps 5 through 8. If a portion of the collected drum core is unused, return the soil to the drum.

14. Immediately after the samples are collected, check sample labels for completeness and initiate Chain of Custody procedures. Place samples in coolers for sample shipment.

15. Decontaminate the sampling equipment (see SOP No. 600).

16. Place drum in overpack and label the overpack with the drum identification number or combine drum contents with other compatible contents, as specified in the task-specific work plan.

3.0 DRUMS WITH UNKNOWN CONTENTS

The procedure for sampling a drum of unknown contents is the same; however, a higher level of PPE and initial external monitoring may be required for opening of the drum. Additionally, if the drum shows evidence of pressurization (i.e., bulging) remote opening techniques may be used and additional health and safety measures may be implemented (e.g., installation of an explosion barrier). Opening of these drums will necessitate the coordination of Site personnel, the Contractor's Project Manager, and health and safety personnel. Extreme caution is required in opening unknown drums,

and all procedures in the HASP as well as the contractor's HASP must be strictly adhered to. Additional discussion pertaining to the health and safety of drum sampling is provided in the HASP. A summary is provided below.

Prior to handling an unknown drum, the following preliminary classification checklist will be reviewed and each response noted in a field notebook:

1. Does the drum contain markings which would indicate that the contents are potentially explosive?

2. Does the drum exhibit leakage or deterioration (i.e., is it sound, does the drum appear to be empty)?

3. Does the drum exhibit apparent internal pressure?

The results of the preliminary inspection will dictate which specific procedures shall be followed in the handling of the drum. The inspection will place each drum in one of three categories: sealed, deteriorated, or drums requiring special handling.

3.1 Sealed Drum Handling

Drums that are sealed, sound and intact and apparently containing material that is not pressurized or potentially explosive will be placed in an overpack and transported to the staging area until they can be opened and the contents sampled as described above. Sealed drums which exhibit bulging indicating internal pressure build-up shall be opened in place, if possible, prior to moving the drum to the staging area. Extreme care shall be exercised when working with and adjacent to potentially pressurized drums. Extra shielding and personnel protection shall be put in place when working with such drums. Special precautions shall be taken to limit and confine any leakage from the drum, which may result from the operation. The drum shall be opened remotely. The drum shall be overpacked or the contents transferred to a new container prior to moving the drum to the staging area. Should movement of a pressurized drum be unavoidable, handling shall only occur by a grappler and/or sling unit constructed for explosive containment.

3.2 Open and Deteriorated Drum Handling

All open drums will be examined to identify contents. Drums that meet the criteria for being considered empty by Resource Conservation and Recovery Act (RCRA) criteria (i.e., less than one inch of residue) will be staged with other debris.

A drum that contains liquids, other than rain water, and exhibits leakage or apparent deterioration such that movement is likely to cause rupture, must have its contents transferred to a new container before the drum is disturbed. Each drum that contains liquids shall be checked with a combustible gas indicator (CGI) for the existence of a potentially explosive atmosphere. If the CGI indicates that the drum atmosphere does not pose an explosion risk, the drum shall also be screened with a (PID) for VOC vapors.

Following the steps described above, drums containing solid or liquid material shall be placed in over-pack containers.

STANDARD OPERATING PROCEDURE NO. 200

SOIL / SLUDGE SAMPLING

Prepared by:____Chris Pracheil_____Date:_07 Nov. 2017

Reviewed by:_____ Date:_____

Approved by:_____ Date:_____

SOP No. 200

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STANDARD OPERATING PROCEDURE NO. 200
SOIL SAMPLING

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the logistics, collection techniques, and documentation requirements for collecting surface soil samples. The soil sampling record to be used during field activities is provided with this SOP.

This SOP will be implemented in accordance with the following governing documents:

- Removal Action Work Plan (RAWP), which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the RAWP;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objective of surface soil sampling (soil samples between ground surface and 36 inches below land surface) is to obtain a representative sample of soil for laboratory analysis. Analytical data will be used to develop potential disposal options. This objective requires that the sample be both free of unsuitable material and be of sufficient quantity and quality for analysis by the selected analytical method.

1.3 Equipment

The following equipment is needed for surface soil sampling:

- Personal Protective Equipment (PPE) as specified in the HASP.
- Sample containers as specified in the FSP and QAPP. Note that samples that are to be analyzed for volatile organic compounds (VOCs) will be collected by the USEPA 5035 Method using the following glassware: one (1) 40 mL VOC vial pre-preserved with 15 mL of methanol, and two (2) 40 mL VOC vials pre-preserved with 5 mL of sodium disulfate. All samples submitted for VOC analysis will also include one small (40 mL to 4 oz) container, to allow the laboratory to record the moisture/dry-weight characteristics.
- Wooden stakes and spray paint (highly visible) or survey pins.
- Field log book and soil sample form (included in SOP) per FSP requirements.
- Sample bottle labels/tags.
- Chain-of-custody forms.
- Hand auger.
- Stainless steel spoon.
- Stainless steel mixing bowl.
- Disposable syringe for VOC sampling.
- Digital scale (accurate to +/- 0.1 grams).
- Indelible marking pens.

2. PROCEDURES

The following procedure should be used for surface soil sampling.

1. Don PPE per the HASP.

2. All surface debris should be removed prior to sampling including wood, paper, sod, gravel, and trash. Identify the sample location and mark with a stake, flagging, or similar marker.
3. Collect the soil using a stainless hand auger. Samples will be collected from a depth of 0-1.0 feet, 1.0-2.0 feet, and 2.0-3.0 feet below land surface. Avoid collection of larger pieces of material (e.g., cobbles, larger rocks). If a matted root zone is present at the sample location, it should be removed prior to sample collection.
4. A pre-cleaned stainless steel spoon or spatula should be used to take the soil sample and fill the sample containers except in the case of a sample for VOC analysis, which is collected using an open-barrel disposable syringe. Care should be taken to avoid sampling anything but soil. Stones, gravel, or vegetation should be removed from the sample since these materials will not be analyzed.
5. For VOC analysis prior to collecting the sample, USEPA Method 5035 specified preservative (5 mL reagent grade water for low level analysis and 15 mL methanol for high level analysis) will be added to 40 mL containers. Each pre-preserved container will then be weighed prior to sample collection, and the container/preservative weight will be recorded on the chain of custody. A digital scale capable of +/- 0.1 gram(s) accuracy will be used to weigh the sample containers in the field.
6. If a sample for VOC is desired it will be collected first using an open barrel, disposable syringe. VOC samples should **never** be homogenized or composited.
7. For a Low Level Analysis the soil will be extruded into a prepreserved VOC vial containing a stir bar, sodium bisulfate (5 mL) and distilled water.
8. If the sample is collected for high level volatile analysis, the sample will be extruded into a VOC vial containing “Purge and Trap” grade methanol (15 mL).
9. The syringe will be filled with undisturbed soil of the following approximate volumes: 5 grams of soil for low-level analysis (added to the soil of reagent grade water); and/or 15 grams of soil for high level analysis (added to the 15 mL of methanol).

10. Any particles of grains present on the container rim or cap will be removed to ensure an adequate seal of the vial. The VOC vial will be capped quickly and labeled/tagged with sample identifications, date, and time of collection. The container/preservative/sample will then be weighed, and the post-collection weight will also be recorded on the chain of custody. The objective sample weights (5 g for low-level analysis, and 15 g for high level analysis) will be achieved (+/- 10%) with the use of the digital scale. Should insufficient sample volume be added to the preserved container, a stainless-steel spatula will be used to add a small portion of sample until the target weight is achieved (or exceeded within 10%).
11. Collect additional material for the remaining parameters by collecting the sample with the stainless steel spoon and transferring the soil into a stainless steel bowl. Homogenize the sample by mixing the sample within the bowl using the stainless steel spoon prior to filling the remaining sample containers.
12. Record the sample location, identification, and time in the field logbook. Complete the sample log sheet with the following:
    - sample identification number;
    - sample location (sketch of the sample point);
    - sample depth;
    - time and date sample was taken;
    - personnel performing the task;
    - visual description of the sample;
    - brief soil description (color, texture, appearance);
    - weights of preserved VOC containers before and after sample collection; and
    - any other pertinent observations.

After the samples have been collected, the sampling location will be marked with wooden stakes colored with highly visible spray paint and labeled/tagged with the location identification in order to record the sample location.

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at 4°C (±2°C) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. VOC samples collected in water have a 48 hour holding time in which to be received by the analytical laboratory. Refer to the Standard Operating Procedure 500 for sample shipping.

Refer to the FSP for equipment decontamination procedures.

STANDARD OPERATING PROCEDURE NO. 500

PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

Prepared by:_____ Date:_22 September 2016_

Reviewed by:_____Date:_____

Approved by:_____ Date:_____

SOP No. 500

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STANDARD OPERATING PROCEDURE NO. 500
PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to establish packaging and shipping requirements and guidelines for environmental sample shipping. Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis.

This SOP will be implemented in accordance with the following governing documents:

- Drum Removal Work Plan (DRWP), which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the DRWP;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The purpose of appropriate packaging and shipping for environmental samples is to protect the integrity of environmental samples shipped for analysis and to ensure that environmental samples arrive at the environmental laboratory in good condition for analysis.

1.3 Equipment

Equipment needed for packaging and shipping of environmental samples includes:

- coolers with return address of site office written on inside lid;
- heavy-duty plastic overbags, cooler-size;
- plastic zip-top bags, small and large;
- plastic packing tape;
- duct tape;
- bubble wrap;
- ice;
- chain-of-custody seals;
- completed Chain-of-Custody Record;
- completed bill of lading or airbill.

The term "Environmental Sample" refers to any sample that has less than reportable quantities of any hazardous constituents according to Department of Transportation (DOT) 49 CFR - Section 172.

2. PROCEDURES

The following steps must be followed when packing for shipment by air:

1. Select a sturdy cooler in good repair. Secure and tape the drain plug (inside and outside) with duct tape.
2. Be sure the caps on all bottles are tight (will not leak); check to see that labels/tags and Chain-of-Custody Records are completed properly.
3. Double-bag ice in large plastic zip-top bags and properly seal.
4. Place all bottles in separate and appropriately-sized plastic zip-top bags and close the bags. Up to three volatile organic compound (VOC) vials may be packed in one bubblewrap envelope placed inside a zip-top bag; alternatively, nine VOC vials may be packed in a foam cube with vial slots, with the cube packed in a zip-top

bag. Glass bottles should be wrapped in bubble wrap before placing in zip-top bags.

5. Place two to four inches of packing peanuts or vermiculite into the bottom of the cooler. Alternatively, place two layers of large-bubble bubble wrap on the bottom of the cooler.
6. Place a clear, cooler-size overwrap bag in the cooler, place one layer of ice and a temperature blank in the bottom of the bag, and then place the bottles in the bag with sufficient space to allow for the addition of a second layer of ice bags over the sample containers. It is preferable to place glass sample bottles and jars into the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather then horizontally.
7. Place the second layer of ice bags on top of the samples. Close and securely fasten the top of the large overbag with tape (preferably duct tape).
8. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-top bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.
9. Packing tape shall be wrapped around each end of the cooler two times, and completed Chain-of-Custody seals affixed to the top opposite sides of the cooler half on the tape so that the cooler cannot be opened without breaking the seal. Wrap clear tape over custody seals.
10. The shipping containers must be marked with THIS END UP, and arrow labels, which indicate the proper upward position of the container, should be affixed to the cooler. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted to be on the outside of the container used to transport environmental samples and shall not be used.

STANDARD OPERATING PROCEDURE NO. 600

EQUIPMENT DECONTAMINATION

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

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STANDARD OPERATING PROCEDURE NO. 004

EQUIPMENT DECONTAMINATION PROCEDURES

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for decontamination of field equipment used in the investigation of sites with hazardous and potentially radiological waste.

1.1Objective

The objective of equipment decontamination is to remove potential contaminants from a sampling device or item of field equipment prior to and between collection of samples for laboratory analysis and limit personnel exposure to residual contamination that may be present on used field equipment.

1.2 Equipment

The following equipment may be utilized when decontaminating equipment. Site-specific conditions may warrant the use or deletion of items from this list.

- Alconox, liquinox or other non-phosphate concentrated laboratory grade soap;
- Deionized water;
- Pump sprayer;
- 1-pint squeeze bottle filled with pesticide-grade hexane;
- 1-pint squeeze bottle filled with pesticide-grade methanol;
- 1-pint squeeze bottle filled with ten (10) percent nitric acid;
- 1-pint squeeze bottle filled with one (1) percent nitric acid;
- Five large plastic wash basins (24 inches by 30 inches by 6 inches deep);
- Two coarse scrub brushes;
- Small wire brush;
- Aluminum foil;
- Polyethylene sheeting;
- Two large capacity barrels;
- All necessary personal protective equipment (gloves, eyewear, tyveks);
- Extra quantities of above listed liquids;

- 4 inch Schedule 40 PVC pipe 4 feet in length with an end cap for decontaminating groundwater pumps and associated tubing (if needed); and
- High pressure sprayer with water supply.

2.0 PROCEDURES

2.1 General

The following procedures should be used for decontaminating field equipment. Procedures will vary with equipment used and potential contaminants present at the site.

2.2 Procedure for Soil Sampling Equipment

Soil sampling equipment, such as split spoon samplers, shovels, augers, trowels, spoons, and spatulas will be cleaned using the following procedure.

1. All tools being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a tool is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Place five wash basins in an established decontamination area that has a low permeability liner (e.g., polyethylene) and secondary containment. The decontamination area must be of sufficient size to allow placement of the five plastic wash basins in a line, and provide an air drying area for equipment.

3. Fill the first wash basin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of the soap or rinsing the soap residue off the equipment will be difficult.

4. Using a clean coarse scrub brush, wash the sampling equipment in the soap solution in the first basin, removing all dirt. Be sure to wash inside surfaces of equipment as well as the exterior surfaces. Allow excess soap to drain off the equipment when finished.

5. Rinse the equipment with tap water in the second basin, using a coarse scrub brush or pressure sprayer to aid in the rinse, if necessary.

6. If the equipment is being used to sample for metals, rinse the equipment with nitric acid in the third basin. A 10 percent solution is used on stainless steel equipment. A one percent solution is used on all other equipment. If no metals sampling is being performed, this step may be omitted.

7. Spray down the equipment in the third basin, using deionized water.

8. Spray down the equipment in the fourth basin, using pesticide-grade methanol, if sampling for organic compounds is to be performed. If oily, a two-step process using methanol, followed by hexane should be used to remove both water soluble and non-soluble compounds. If no samples for organic compounds are being collected, this step may be omitted.

9. Allow the equipment to completely air dry on clean polyethylene sheeting.

10. Rinse the equipment in the fifth basin, using deionized water.

11. Allow the equipment to completely air dry on clean polyethylene sheeting.

12. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport. Re-use of equipment on the same day without wrapping in foil is acceptable.

13. Allow spent cleaning solutions in the trays to evaporate into the air. If evaporation is not possible, all spent cleaning solutions shall be drummed for disposal along with any other contaminated fluids generated during the field investigation.

14. Record the decontamination procedure in the field logbook or on appropriate field form.

15. If step 8, rinsing with organic solvents, was performed, check the equipment for the presence of residual solvents with a photoionization or flame ionization detector prior to use. If a detection occurs, disassemble the equipment and allow to air dry until no readings are observed, then re-rerinse with deionized water.

16. If a tool that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

17. If the tool cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The tool shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

Note that if temperature or humidity conditions preclude air drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air dry equipment completely prior to reuse should be noted in the field logbook. In this case, additional rinses with deionized water should be used and recorded.

2.3 Procedure for Ground Water Sampling Equipment

Ground water sampling equipment, such as bailers and stainless steel cord, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Place five wash basins in an established decontamination area that has a low permeability liner (e.g., polyethylene) and secondary containment. The decontamination area must be of sufficient size to allow placement of the five plastic wash basins in a line, and provide an air drying area for equipment.

3. Fill the first wash basin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of soap or rinsing the soap residue off the equipment will be difficult.

4. Wash the sampling equipment in the soap solution in the first basin, removing all residues. Be sure to wash inside surfaces of equipment as well as exterior surfaces. Allow excess soap to drain off the equipment when finished.

5. Rinse the equipment with tap water in the second basin.

6. If the equipment is being used to sample for metals, rinse the equipment with nitric acid in the third basin. A 10 percent solution is used on stainless steel equipment. A one percent solution is used on all other equipment. If no metals sampling is being performed, this step may be omitted.

7. Spray down the equipment in the third basin, using deionized water.

8. Spray down the equipment in the fourth basin, using pesticide-grade methanol, if sampling for organic compounds is to be performed. If oily, a two-step process using methanol, followed by hexane should be used to remove both water soluble and non-soluble compounds. If no organic compounds sampling is being performed, this step may be omitted.

9. Allow the equipment to completely air dry on clean polyethylene sheeting.

10. Rinse the equipment in the fifth basin, using deionized water.

11. Allow the equipment to completely air dry on clean polyethylene sheeting.

12. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport. Re-use of equipment on the same day without wrapping in foil is acceptable.

13. Allow spent cleaning solutions in the trays to evaporate into the air. If evaporation is not possible, all spent cleaning solutions shall be drummed for disposal along with any other contaminated fluids generated during the field investigation.

14. Record the decontamination procedure in the field logbook or appropriate field form.

15. If step 8, rinsing with organic solvents, was performed, check the equipment for the presence of residual solvents with a photoionization or flame ionization detector prior to use. If a detection occurs, disassemble the equipment and allow to air dry until no readings are observed. Re-rinse with deionized water.

16. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

17. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

Note that if temperature or humidity conditions preclude air drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air dry equipment completely prior to reuse should be noted in the field log. In this case, additional rinses with deionized water should be used and recorded.

2.4 Procedure for Oversized Equipment

Oversized equipment, such as submersible pumps, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Fill two clean barrels with tap water.

3. Add sufficient concentrated soap to one barrel to form a thin layer of soap suds.

4. Immerse the pump in the soap containing barrel and start pump. Circulate the soap solution through the pump and feed discharge into a waste disposal drum.

5. Immerse the pump in the barrel filled with clean tap water and start pump. Circulate the water through the pump and feed discharge into a waste disposal drum. Run the pump until no soap residue is visible in the discharge.

6. Deionized water should then be run through the pump and used to rinse all submersible parts and hoses.

7. Record the decontamination procedure in the field logbook or appropriate field form.

8. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

9. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

2.5 Procedure for Measuring Equipment

Measuring equipment, such as pressure transducers or water level indicators, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Fill two clean basins with tap water.

3. Add sufficient concentrated soap to one basin to form a thin layer of soap suds.

4. Immerse the device in the soap containing basin and gently agitate. Scrub device if it is soiled. Do not submerse any electrical connectors or take up reels, only that portion of the device in contact with potentially contaminated water.

5. Immerse the device in the basin containing the rinse water and gently agitate. Do not submerse any electrical connectors or take up reels, only that portion of the device in contact with contaminated water.

6. Spray rinse equipment with deionized water.

7. Allow the equipment to air dry.

8. Record the decontamination procedure in the field logbook or appropriate field form.

9. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

10. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

ATTACHMENT 1

CONTAMINATED PERSONNEL OR PERSONAL EFFECTS REPORT

DATE OF INCIDENT:	TIME OF INCIDENT:
NAME:	BADGE NO.
LOCATION OF INCIDENT (SPECIFIC AREA)	
DESCRIPTION	DESCRIBE IN DETAIL ANATOMICAL LOCATION, CONTAMINANT, TYPE OF INJURY, OR CONTAMINATED ARTICLE

CONTAMINATED ARTICLE OR AREA	DECONTAMINATION AGENT USED	INSTRUMENT	SURVEY RESULTS		FINAL DISPOSITION OF ARTICLES
			BEFORE	AFTER	

WOUND COUNT /5 MIN	BKGD COUNT /5 MIN	SOURCE COUNT /5 MIN

	PERTINENT SAFETY MEASURES IN EFFECT ☐ YES ☐ NO	IF NO, EXPLAIN
SAFETY MEASURES		
REMARKS		

EMPLOYEE SIGNATURE	HEALTH PHYSICS SIGNATURE

EPA Region 8
1595 Wynkoop Street
Denver, Colorado 80202

DRAFT QUALITY ASSURANCE PROJECT PLAN (QAPP)

NEUHAUSER LANDFILL

DRUM REMOVAL WORK PLAN

ERIE, WELD COUNTY, COLORADO

Geosyntec Consultants
5670 Greenwood Plaza Blvd. Suite 540
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Prepared by: _____ Date: _____

Christopher Pracheil – Geosyntec

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Approved by: _____ Date: _____

Joyce Ackerman - EPA Region 8 On-Scene Coordinator

CROSSWALK TABLE: **ELEMENTS OF THE UFP-QAPP AND EPA QA/R-5 IN RELATION TO THIS QAPP**

UFP-QAPP Worksheet		EPA QA/R-5		Geosyntec QAPP	Crosswalk to other project Documents
#1	Title and Approval Page	A1	Title and Approval Sheet	Title Page	--
#2	QAPP Identifying Information	--		Table of Contents and Section 1.1	--
#3	Distribution List	A3	Distribution List	Distribution List	--
#4	Project Personnel Sign-Off Sheet			Title Page	--
#5	Project Organization Chart	A4	Project/Task Organization	Section 2.1 and Figure 1	--
#6	Communication Pathways	--		--	Geosyntec Project Management Plan (internal use document)
#7	Personnel Responsibilities and Qualifications Table	A4	Project/Task Organization	Section 2.1 and Figure 1	--
#8	Special Personnel Training Requirements Table	A8	Special Training/ Certification	Section 2.5	--
#9	Project Scoping Sessions Participants Sheet	--		NA	--
#10	Problem Definition	A5	Problem Definition/ Background	Section 2.2	--
#11	Project Quality Objectives/Systematic Planning Process Statements	A7	Quality Objectives and Criteria	Section 2.4	--
#12	Measurement Performance Criteria Table	A7	Quality Objectives and Criteria	Section 2.4, Tables 2a – 2d	--
#13	Secondary Data Criteria and Limitations Table	B9	Non-Direct Measurements	NA	--
#14	Summary of Project Tasks	A6	Project/Task Description	Section 2.3	--
#15	Reference Limits and Evaluation Table	--		Tables 1a -1c	--
#16	Project Schedule/ Timeline Table	--			Work Plan Section 6

UFP-QAPP Worksheet	EPA QA/R-5	Geosyntec QAPP	Crosswalk to other project Documents
#17 Sampling Design and Rationale	B1 Sampling Process Design (Experimental Design)	Section 3.1	--
#18 Sampling Locations and Methods/SOP Requirement Table	B2 Sampling Methods	Section 3.2, Table 3	FSP Table 1
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#20 Field Quality Control Sample Summary Table	B5 Quality Control	Section 3.5, Table 5	FSP Section 2.5
#21 Project Sampling SOP Reference Table	B2 Sampling Methods	Section 3.2	FSP Section 2.1.3, Appendix C
#22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table	B6 Instrument/Equipment Testing, Inspection, and Maintenance B7 Instrument/Equipment Calibration and Frequency B8 Inspection/Acceptance of Supplies and Consumables	NA Section 3.8	--
#23 Analytical SOP Reference Table	B4 Analytical Methods	Attachment B	--
#24 Analytical Instrument Calibration Table	B7 Instrument/Equipment Calibration and Frequency	Section 3.7, Attachment B	--
#25 Analytical Instrument and Equipment, Maintenance, Testing, and Inspection Table	B6 Instrument/Equipment Testing, Inspection, and Maintenance	Section 3.6, Attachment B	--
#26 Sampling Handling System	B3 Sample Handling and Custody	Section 3.3, Table 4, Attachment B	FSP Section 3
#27 Sample Custody Requirements	B3 Sample Handling and Custody	Section 3.3, Attachment A	FSP Section 3
#28 QC Samples Table	B5 Quality Control	Section 3.5, Table 5	FSP Section 2.5
#29 Project Documents and Records Table	A9 Documents and Records B10 Documentation/Data Management	Section 2.6 Section 3.10	--
#30 Analytical Services Table	B4 Analytical Methods	Section 3.4	--
#31 Planned Project Assessment Table	C1 Assessments and Response Actions	Section 4.1	--
#32 Assessment Findings and Response Actions	C1 Assessments and Response Actions	Section 4.1	--

UFP-QAPP Worksheet	EPA QA/R-5	Geosyntec QAPP	Crosswalk to other project Documents
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#34 Sampling and Analysis Verification (Step 1) Process Table	D1 Data Review, Verification, and Validation D2 Data Verification and Validation Methods	Section 5.1.3	--
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#36 Sampling and Analysis Validation (Steps 2a and 2b) Summary Table	D1 Data Review, Verification, and Validation D2 Data Verification and Validation Methods	Section 5.1.3	--
#37 Data Usability Assessment	D3 Reconciliation with User Requirements	Section 5.1.4	--

I certify that this QAPP complies with the Final Version 1 (March 2005) UFP-QAPP and the EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5).

_____ _____

Julia K. Caprio (Geosyntec QA Representative) Date

DISTRIBUTION LIST

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Note: QAPP – Quality Assurance Project Plan

Prepared for

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DRAFT

QUALITY ASSURANCE PROJECT PLAN

NEUHAUSER LANDFILL
DRUM REMOVAL WORK PLAN
WELD COUNTY ROADS 5 AND 6
ERIE, COLORADO

Prepared by

Geosyntec consultants
engineers | scientists | innovators

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Project Number DE0302

December 2017

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Administrative Settlement Agreement and Order on Consent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
CLP	Contract Laboratory Program
CPR	Cardiopulmonary Resuscitation
DMP	Data Management Plan
DQI	Data Quality Indicators
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
GIS	Geographic Information System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ICP	Inductively-Coupled Plasma
ID	Identification
LCS	Laboratory Control Sample
LCS	Laboratory Control Sample Duplicate
LPM	Laboratory Project Manager
MDL	Method Detection Limit
MQO	Measurement Quality Objectives
MS	Matrix Spike
MSD	Matrix Spike Duplicate
%R	Percent Recovery
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PCB	Polychlorinated Biphenyl
PE	Performance Evaluation
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control

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QMP	Quality Management Plan
RI	Remedial Investigation
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
TAL	Target Analyte List
UFP	Uniform Federal Policy
VOC	Volatile Organic Compound

1. INTRODUCTION

1.1 Objectives

This Quality Assurance Project Plan (QAPP) has been prepared as part of the drum removal work plan (DRWP) for the Neuhauser Landfill Drum Removal Site (Site) located in Erie, Colorado. The DRWP is required by an Administrative Settlement Agreement and Order on Consent Docket Number CERCLA-08-2018-0002 (AOC) entered voluntarily by the United States Environmental Protection Agency (EPA) and Stratus for removing buried drums located at certain property more specifically described in Figure 1 located in Weld County, Colorado Site (the "Site").

This QAPP is one of several DRWP Planning Documents submitted concurrently in fulfillment of paragraph 32 of Section VIII (Work to Be Performed) of the AOC.

1.2 Document Overview

This QAPP has been prepared according to the following EPA guidance documents:

- "EPA Requirements of Quality Assurance Project Plans (EPA QA/R-5)" (EPA/240/B-01/003, March 2001, reissued May 2006);
- "Guidance for Quality Assurance Project Plans (EPA QA/G-5)" (EPA/240/R-02/009, December 2002);
- "Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4)" (EPA/240/B-06/001, February 2006); and
- "Uniform Federal Policy for Quality Assurance Project Plans" (Part 1 UFP-QAPP Manual, Intergovernmental Data Quality Task Force, March 2005, Version 1).

This QAPP has been structured to present a standardized format which incorporates the approach described by the Guidance for Quality Assurance Project Plans (EPA QA/G-5) and includes all the elements specified by UFP-QAPP guidance as illustrated by the crosswalk table above. The major sections of this QAPP correspond to the sections prescribed in the QAPP guidance documents as follows:

- Sections 1 and 2 of this QAPP and the preceding signature page and table of contents address Group A, Project Management;

- Section 3 of this QAPP addresses Group B, Data Generation and Acquisition;
- Section 4 of this QAPP addresses Group C, Assessment and Oversight;
- Section 5 of this QAPP addresses Group D, Data Validation and Usability; and
- Section 6 of this QAPP provides references cited.

Note that certain recommended topics from EPA guidance concern field sampling protocols. Generally, these protocols, which are also discussed in the Field Sampling Plan (FSP), appear in the Standard Operating Procedures (SOPs); hence, they are briefly described in this QAPP. The reviewer is referred to SOPs in accordance with guidance.

2. PROJECT MANAGEMENT

2.1 Project/Task Organization

A project organization chart is presented in Figure 1. It presents the personnel involved and the lines of authority. A description of the key personnel and their responsibilities are presented below, all personnel will have stop work authority to address health and safety, quality control and/or regulatory issues. Project-specific training requirements are discussed in Section 2.5.

- **Regulatory Managers:** Ms. Joyce Ackerman, On-Scene Coordinator (OSC), EPA Region 8 (303-312-6822).

The OSC, located at 1595 Wynkoop Street, Denver, CO 80202, provides oversight of the DRWP Investigation and serves as the point of contact for Stratus with EPA Region 8. Deliverables provided to the EPA for review and approval will be submitted to the attention of Ms. Ackerman.

- **Project Manager:** Mr. Thomas Krasovec, Geosyntec (303-790-1340).

Mr. Krasovec, located at 5670 Greenwood Plaza Blvd. Suite #540, Greenwood Village, CO 80111 is responsible for the execution of DRWP tasks performed by Geosyntec, including plan development, field programs, data analysis, and reporting tasks. Subordinate members of the Geosyntec Team, including the Field Supervisor, report directly to him. He also manages the performance of analytical and removal action subcontractors. Mr. Krasovec is an engineer with more than 25 years of experience in site investigation and remediation.

Mr. Krasovec, also serves as the Project Coordinator and has responsibility for overseeing the investigation on behalf of Stratus Redtail Ranch LLC (Stratus), including representing Stratus on technical matters with EPA. The Project Coordinator will coordinate the submittal and routing of official correspondence with EPA.

- **Quality Assurance (QA) Manager:** Ms. Julia K. Caprio, Geosyntec (865-330-0037).

The QA Manager, located at 180A Market place Blvd, Knoxville, Tennessee 37922 is responsible for assuring the integrity of the QAPP and will coordinate QA-specific activities. The QA Manager will do the following:

1. ensure that the appropriate analytical methods and sampling equipment are selected;

2. be responsible for data validation and advise the Project Manager with respect to data management and statistical evaluation of the data; and

3. be responsible for performance and/or systems audits of the laboratory, should they be required.

Ms. Caprio is a QA specialist with over 30 years of experience in the environmental field, specializing in site evaluation, data verification, data evaluation, data validation, and field and laboratory audits.

Field Supervisor: Jackie Rowley/Patrick Medland, Geosyntec

The Field Supervisor, or designated representative, will be located at the Site during field activities and will coordinate the technical field activities in accordance with approved plans, including the DRWP, FSP, QAPP, and HASP. They are responsible for verifying that the field work (to include sampling operations and sampling QC) is performed within the approved guidelines. The Field Supervisor is responsible for implementing and maintaining overall operating standards and field QA responsibilities. Such responsibilities will include the following:

1. appropriate calibration and maintenance of field instruments;

2. appropriate field documentation;

3. ensuring that appropriate equipment decontamination is performed; and

4. monitoring compliance with QA/QC sampling requirements (e.g. field duplicate collection).

They will coordinate safety and technical activities occurring at the site, and conduct daily briefing sessions prior to work on the Site. Although various field functions will be performed by individuals, it is the Field Supervisor who will bear field responsibilities.

- **Laboratory Project Manager:** Mr. David Dunlap, TestAmerica Pittsburgh (412 963 7058)

TestAmerica Pittsburg is located at 301 Alpha Drive, Pittsburgh, Pennsylvania. TestAmerica Denver is located at 4955 Yarrow Street, Arvada, Colorado. TestAmerica Irvine is located at 17461 Derian Avenue, Irvine, California 92614. Other certified laboratories have been identified should laboratory capacity become an issue.

The Laboratory Project Manager (LPM) is responsible for the day-to-day management of the laboratory work, to include: (i) data processing and data processing QA; and (ii) verification that laboratory QA/QC procedures are being maintained and that a technical review of reports has been performed. Although various laboratory functions will be performed by different individuals, it is the LPM who will provide signature approvals to laboratory-generated information and bear laboratory responsibilities.

2.2 Problem Definition/Background

2.2.1 Site Location

The Site is located on the northwest corner of County Roads (CR) 4 and 5 in Erie, Weld County, Colorado (Section 29, Township 1 North, Range 68 West). The Site is bounded by the Front Range landfill on the east side of CR5, residential properties to the south of CR4, and the Denver Regional Landfill and Old Erie Landfill to the northwest and north of the Site, respectively. More detailed description of the Site location is found in Section 2 of the DRWP.

2.2.2 Site Background and Problem Summary

From approximately 1965 until 1969, the operator of the Site, Sanitation Engineering, Inc., and its principal, John Neuhauser, contracted with various entities, including International Business Machine Company (IBM), for the disposal of Waste Material, which may have included drums containing liquid chemical waste and solid waste from IBM and other entities. All or a portion of this Waste Material was disposed of at the Site.

In 2015, prior to acquisition of the Site, Stratus engaged a qualified environmental professional to perform all appropriate inquiry of the Site (the "Phase 1 Environmental Study"). The Phase 1 Environmental Study failed to identify any indication of landfill activity on the Site or the disposal of drums on the Site. Following completion of the Phase 1 Environmental Study, Stratus purchased the Site together with approximately 265 additional acres of property

Stratus intends to develop a portion of the Site for open space as an amenity for the portion of the property purchased by Stratus in 2015, which Stratus intends to develop as residential property. Following purchase of the Site, at the request of the CDPHE and in effort to undertake reasonable steps as contemplated by Section 101(35) (B)(i) of CERCLA, 42 U.S.C. § 9601(35), Stratus conducted additional environmental studies, including groundwater investigations that were submitted to CDPHE. Groundwater reports at the Site show levels of trichloroethylene (TCE), cis-1,2 dichloroethylene, methyl ethyl ketone (MEK), and toluene in groundwater, indicating some contents from the drums have been released into groundwater. CDPHE conducted a review of available historical documents within CDPHE records and concluded that the Site was used as a landfill location for drum waste and other solid waste generated by IBM and other entities.

In January 2017 and in July 2017, Stratus conducted additional investigation at the Site and found buried drums with liquids still inside. Samples of the liquids showed the presence of MEK, toluene, 4-methyl-2-pentanone (MIBK), cis-1,2 DCE and TCE. Drums were found in two areas within the Site, and in some cases, are located close to the ground surface. In some instances, strong solvent odors existed as the drums were exposed, indicating that a release of the drums' contents may have occurred. MEK, toluene, MIBK, TCE, and cis-1,2 DCE are hazardous substances.

2.2.3 Problem Statement

Site investigation activities have identified buried drums on Site that are known to contain hazardous materials and must be removed prior to further Site remedial activities.

2.2.4 Project/Task Description and Schedule

Section 2.2.3 presents the problem statement for the DRWP. The DRWP will address the problem described above by including the following tasks:

Removal of waste drums and surrounding contaminated soils:

- prepare a clear, safe, and stable operational work zone near the drum storage area to allow for assessment and segregation of the excavated drums;
- to the extent practicable prepare an inventory of the buried storage drums;
- remove and dispose of waste materials, including impacted soil, collected and generated at the Site in accordance with applicable and appropriate requirements for on-Site activities and the federal and State laws governing waste transportation and disposal to an off-Site approved facility;
- bulking of materials and disposal off-Site at a facility that is in compliance with federal regulations and has been approved by the EPA in accordance with the CERCLA off-site rule in the national contingency plan; and
- conduct field observations and confirmation soil testing to confirm soil visibly contaminated by leaking drum or container contents; soil with a strong odor consistent with drum or container contents; soil with total volatile organic compound (VOC) concentrations of 100 ppm or greater as determined by soil

sample head-space screening using a PID; and soil with hazardous waste characteristics has been removed.

Tables 1a through 1c provide data with regard to target compounds, matrix, Project Action Limits, and laboratory specific Quantitation Limits i.e. reporting limits. Separate tables are provided for soil/sludge, liquid waste and soil confirmation sample matrices.

The approximate project schedule (Figure 3) is discussed in the DRWP.

2.4 Quality Objectives and Criteria

2.4.1 Introduction

Presented below is a brief discussion of the Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) for the project, along with the methods used to evaluate data quality. (A more thorough discussion of the DQO process is described in Section 3 of this document.)

2.4.2 Data Quality Objectives

DQOs are qualitative and quantitative statements that clarify the project objectives, specify the most appropriate type of data for the project decisions, determine the most appropriate conditions from which to collect data, and specify tolerable limits on decision errors. DQOs are based on the end uses of the data and are determined through a seven-step process as described in QA/G-4 (EPA, 2006). In addition to the project objectives, the DQOs specify data collection boundaries and limitations, the most appropriate type of data to collect, and the level of decision error that will be acceptable.

The DQO process is a series of planning steps based on scientific methods that are designed to ensure that the type, quantity, and quality of environmental data used for decision-making are appropriate for the intended application. The DQO process, as defined by EPA, consists of seven steps that are designed to provide a systematic approach to resolving issues that pertain to site investigation and remediation (EPA, 2006). The DQOs for this project were developed from discussions with the stakeholders, technical experts, quality assurance staff, laboratory representatives, and project management, as well as from available historical data and information. Section 3 of the QAPP describes the outcome of the seven-step DQO process for data collection activities to be conducted as part of the DRWP at the Site.

2.4.3 PARCCS Overview

2.4.3.1 Introduction

This QA program addresses both field and laboratory activities. QA objectives are formally measured through the computation of performance measures known as DQIs, which are in turn compared to pre-defined Measurement Quality Objectives (MQOs) specific to the project objectives. The DQIs for measurement data are expressed in terms of precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). Evaluation of DQIs provides the mechanism for ongoing control and evaluation of data quality throughout the project and ultimately will be used to define the data quality achieved for the various measurement parameters. The field QA/QC program will be accomplished through the collection of field duplicates, equipment blanks, field blanks, and trip blanks as applicable. The analytical QA/QC program will be assessed through the internal laboratory QC performed, including method blanks, laboratory control sample (LCS) recoveries, surrogate recoveries, and matrix spike/matrix spike duplicate (MS/MSD) recoveries. The following sections describe the DQIs in greater detail, with a discussion of the associated MQOs.

2.4.3.2 Precision

Precision refers to the reproducibility or degree of agreement among duplicate measurements of a single analyte. The closer the numerical values of the measurements, the more precise the measurement. Poor precision stems from random errors (i.e., mechanisms which can cause both high and low measurement errors at random). Precision is usually stated in terms of standard deviation, but other estimates, such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum values), and relative range are common, and may be used pending review of the data.

Precision will be determined through the collection of field duplicates and the analysis of MS/MSD and LCS/Laboratory Control Sample Duplicate (LCSD) samples for the work performed at the Site. The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is much easier to control and quantify than sampling precision; there are more historical data related to individual method performance, and the "universe" is not limited to the samples received in the laboratory. In contrast, sampling precision is unique to the project. Sampling precision will be measured through the laboratory analysis of field duplicate samples. Laboratory precision

will be measured through the analysis of MS/MSD, LCS/LCSD pairs and laboratory duplicate pairs.

During the collection of data using field methods and/or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Precision will be determined from replicate samples and will be expressed as the relative percent difference (RPD) between replicate/duplicate sample results, computed as follows:

$$RPD = \frac{X_1 - X_2}{\left(X_1 + X_2\right)/2} \times 100$$

where X_1 and X_2 are reported concentrations for each replicate sample and subtracted differences represent absolute values. For field duplicates, the precision goals for this project are as follows: (i) RPD = 50% for solid samples; (ii) RPD = 30% for liquid samples. For laboratory duplicates, the RPD goals are shown in Tables 2a and 2b.

2.4.3.3 Accuracy and Bias

Accuracy refers to the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement. The converse of accuracy is bias, in which a systematic mechanism tends to consistently introduce errors in one direction or the other. Bias in environmental sampling can occur in one of three ways; these mechanisms and their associated diagnostic and management methods are as follows:

- High bias, which can stem from cross-contamination of sampling, packaging, or analytical equipment and materials. Cross-contamination is monitored through blank samples, such as equipment blanks, field blanks, trip blanks, filter blanks, and method blanks. These samples assess the potential for cross-contamination from, respectively, sampling equipment, ambient conditions, packaging and shipping procedures, field filters, and laboratory equipment. Data validation protocols described in Section 5 present a structured approach for data qualification based on blank samples.

- Low bias, which can stem from the dispersion and degradation of target analytes; an example is the volatilization of chlorinated solvents during field sampling. The effects of these mechanisms are difficult to quantify. Sampling accuracy can be maximized; however, by the adoption and adherence to a strict field QA program. Specifically, sampling procedures will be performed following standard protocols described in the FSP; for example, eliminating headspace in sampling vials for VOCs will reduce the potential for dispersion of VOCs during sampling. Through regular review of field procedures, deficiencies will be documented and corrected in a timely manner.

- High or low bias, due to poor recoveries, poor calibration, or other system control problems. The effects of these mechanisms on analytical accuracy may be expressed as the percent recovery of an analyte that has been added to the environmental sample at a known concentration before analysis. Analytical accuracy in the laboratory will be determined through the analysis of LCSs and MS/MSDs. As with blank samples, data validation protocols provide a structured formula for data qualification based on erroneously high or low analyte recoveries.

Accuracy, when potentially affected by high or low recoveries as described in the third bullet above, is presented as percent recovery (%R), defined as:

$$\% R = \frac{Spiked\ Sample\ Concentration - Sample\ Concentration}{Spike\ Concentration} \times 100$$

Accuracy goals for analytical results are presented as upper and lower control limits for percent recovery in Tables 2a and 2b.

2.4.3.4 Representativeness

Representativeness is defined by the degree to which the data accurately and precisely describe a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. If the results are reproducible, the data obtained can be said to represent the environmental condition. Representativeness is ensured by collecting sufficient numbers of samples of an environmental medium, properly chosen with respect to place and time. The precision of a representative set of samples reflects the degree of variability of the sampled medium, as well as the

effectiveness of the sampling techniques and laboratory analysis. Representativeness will be determined with EPA concerning appropriate sampling scope.

2.4.3.5 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same for data uses in that sufficient amounts of valid data are to be generated.

There are limited historical data on the completeness achieved by individual methods. However, the CLP data have been found to be 80 to 85 percent complete on a nationwide basis.

The percent completeness for each set of samples will be calculated as follows:

$$\%\ Completeness = \frac{Valid\ Data}{Total\ Data\ Planned} \times 100$$

The QA objective for completeness for the parameters will be 90 percent.

2.4.3.6 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured using established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, etc.), consistency in reporting units (µg/L, mg/L), and analysis of standard reference materials. By using standard sampling and analytical procedures, data sets will be comparable.

2.4.3.7 Sensitivity

Sensitivity refers to the minimum magnitude at which analytical methods can resolve quantitative differences among sample concentrations. If the minimum magnitude for a particular analytical method is sufficiently below an action level or risk screening criterion, then the method sensitivity is deemed sufficient to fully evaluate the dataset with respect to the desired reference values. Frequently, risk-based screening levels fall below the sensitivity of even the most sensitive analytical methods. In such cases, it is

necessary to review the qualifications of several laboratories, both from the standpoint of sensitivity as well as other DQIs, to select the best laboratory for the project.

The method detection limit (MDL) is a theoretical limit determined through an MDL study, in which the concentration of a spiked solution is tested at least seven times and the concentration of method blanks is tested at least seven times. The standard deviation of the recovered concentrations (σ_{rec}) is computed and multiplied by the Student's t-distribution value to arrive at the MDL. The higher of the two MDLs is then used as the MDL for the analyte and test method. The reporting limit (RL) is a quantifiable value and usually the lowest concentration standard used in the calibration curve. In practice, to allow for matrix interferences variability in instrument control, a RL of 3 to 8 times the MDL is typically selected.

Analytical sensitivity is readily evaluated by comparing method RLs to risk-based screening values, such as EPA Regional Screening Levels (RSLs). The results of this analysis are presented in Tables 1a and 1b, which demonstrate the suitability of the selected methods to the project requirements.

2.5 Special Training/Certifications

Health and safety training will include the following:

- initial training of site workers in 40-hr Hazardous Waste Operations and Emergency Response (HAZWOPER), per 29 Code of Federal Regulation (CFR) 1910.120, with supervisor training for the Field Manager and annual 8-hr refresher training thereafter for field staff;
- annual training in cardiopulmonary resuscitation (CPR);
- triennial first aid training; and
- baseline and annual medical monitoring.

Training and monitoring protocols are Geosyntec requirements; Geosyntec's intranet training compliance database will be used to comply with these requirements.

Subcontractors performing work during the DRWP will be required to conduct activities in accordance with applicable health and safety regulations (e.g., CFR 1910.120) and site-

specific requirements. A copy of the HASP will be provided as an addendum to the ACT HASP which will be the primary Site HASP. However, each company working on the site will be responsible for the health and safety of their personnel while working at the Site. Each day before work commences, a tailgate health and safety meeting shall be conducted by the ACT Project Manager with participation by all personnel working on the site.

Sampling activities conducted during the DRWP will be performed by individuals with training and experience in the specific sampling and monitoring techniques. Individuals collecting samples will be trained on the specific requirements as provided in SOPs referenced by the FSP where necessary.

2.6 Documentation and Records

Documentation involves generating, maintaining, and controlling field data, laboratory analytical data, field logs, reports, and any other data relevant to the project. Bound field log books, loose-leaf drilling logs, or automated field data entry records generated with personal data assistants (PDAs) are examples of documents. This project will have dedicated field log books and/or field forms, and databases that will not be used for other projects. Entries will be dated, and the time of entry will be recorded. Sample collection data as well as visual observations will be documented on forms or PDAs or, when forms are not available or applicable, in the field log book. To the extent possible, field data will be recorded on field forms or PDAs and not repeated in the field notebook. Any sample collection equipment, field analytical equipment, and equipment used to make physical measurements will be identified in the field documentation. Calculations, results, equipment usage, maintenance, and repair and calibration data for field sampling, analytical, and physical measurement equipment will also be recorded in field documentation. Once completed, the field forms, field databases, and field log book will become part of the project file.

Office data management will involve establishing and maintaining a project file. The project file will include the following:

- DRWP planning documents, such as this QAPP;
- plans and schedules;
- SOPs (for both the field and laboratory);

- field sampling logs;
- field screening data;
- QA auditing and inspection reports;
- laboratory analytical data;
- calculations;
- drawings and figures;
- reports;
- external and internal correspondence;
- notes/minutes of meetings and phone conversations;
- contract/purchase orders; and
- change orders.

Project-related information will be routed to the Project Manager who will be responsible for distributing the information to appropriate personnel. A standardized document numbering system will be established in Geosyntec's Denver, Colorado office. The official project files will be maintained in Geosyntec's Denver, Colorado office. The document numbering system will be used to assist in document filing and retrieval. Project documentation will be archived for a minimum of ten years, as required by the AOC.

3. DATA GENERATION AND ACQUISITION

3.1 Experimental Design

3.1.1 Introduction

To generate data that will meet the project objectives, it is necessary to define the types of decisions that will be made, identify the intended uses of the data, and design a data collection program. These are steps in the DQO process. DQOs entail the desired type, range of applicability, and quality of data based on desired decisions and acceptable decision errors. Articulating DQOs is necessary to ultimately obtain sufficient data of known defensible quality for the intended use. The DQO process will assist in determining the necessary quantities, quality, sensitivity, sample handling procedures, and data assessment requirements for the data collected.

The DQO development presented herein adheres to the framework presented in the EPA document "Guidance on Systematic Planning Using the Data Quality Objectives Process" (EPA QA/G-4).

3.1.2 Step 1 – State the Problem

Buried drums at the Site were identified as containing CERCLA hazardous substances and must be removed, characterized and disposed of prior to further property development. A scope of work has been developed for the DRWP based on the results of the reconnaissance and earlier fieldwork as well as from input received from the EPA and CDPHE as of November 2017.

3.1.3 Step 2 – Goal of the Drum Removal Work Plan

The DQO guidance document suggests two main types of study problems:

- decision problems, in which the goal of the study is an explicit yes/no decision, such as confirming or refuting an exceedance of a regulatory criterion; and

- estimation problems, in which the study goal is an understanding of the nature of a population distribution, which may be as simple as understanding a mean concentration or as complex as developing a spatial model of variability.

The tasks listed for the DRWP, include characterization programs as the critical components which are classified as decision problems. These characterizations will include the following activities:

- assessment of waste drum liquids to develop an appropriate disposal strategy;
- assessment of the soils and sludge where waste drums were stored to develop an appropriate disposal strategy; and,
- delineate extent of soils impacted by stockpiled waste drums.

These three tasks are considered decision problems as opposed to estimation problems.

3.1.4 Step 3 – Identify Information Inputs

Inputs to the decision include the type, quality, and quantity of data that will be collected to make decisions. Data type refers to the matrix from which physical and chemical data are collected as well as the presence or absence of special data collection and analysis circumstances, such as field filtering or Toxicity Characteristic Leaching Procedure (TCLP) extraction. Quality refers to the technical rigor that underlies the collected data, which can be quantified or otherwise described through the PARCCS considerations described in Section 2. Quantity refers to the amount of data necessary to make appropriate decisions. PARCCS goals are discussed in Section 2 of this QAPP. Considerations of data type and quantity are addressed in the FSP and DRWP, whereas considerations of quality are addressed in this QAPP. Table 3 indicates the approximate number of liquid waste, and soil/sludge samples to be collected during the DRWP.

The following sampling is planned (numbers are approximate and may be adjusted based on field observations):

- Waste drums will be sorted by container labels and physical characteristics when possible and composite samples will be collected from the sorted waste drums with a maximum of five drums per composite sample. However, discrete samples for VOC analysis will be collected, unless a multi-increment sampling strategy is employed. Alternately, one sample may be used to characterize up to five drums when the drum contents appear to be from a common source, based on the nature and source of contamination, drum labeling, and field screening information, as

approved by the EPA OSC. Drums that cannot be sorted will be individually sampled;

- Excavated soil and sludge that is visibly contaminated by leaking drums or container contents; has a strong odor consistent with drum or container contents; or has a total VOC concentrations of 100 ppm or greater as determined by soil sample head-space screening using a PID,will be drummed and samples will be collected from no less than 20% of the soil/sludge drums. However, discrete samples for VOC analysis will be collected, unless a multi-increment sampling strategy is employed. Alternately, one sample may be used to characterize up to five drums when the drum contents appear to be from a common source, based on the nature and source of contamination and field screening information, as approved by the EPA OSC;

- one composite soil sample will be collected for every 50 cubic yards of excavated soil that does not meet the criteria for being drummed, to develop a waste profile, However, discrete samples for VOC analysis will be collected, unless a multi-increment sampling strategy is employed. Alternately, one sample may be used to characterize up to 50 cubic yards of soil when the soil appears to be homogeneous, based on the nature and source of contamination and field screening information, as approved by the EPA OSC.;

- confirmation samples will be collected from sidewalls of the excavation area a minimum of one per 250 feet and one confirmation sample per every 2500 square feet will be collected from the floor of the excavation area.

The number of waste drum samples will be determined once the containers are identified and grouped. Samples will be analyzed per the methods listed in Tables 1a, 1b, and 4**.**

Inputs to the decision will include the following:

- waste drum sample data will serve as input to the drum disposal decision;

- drummed soil/sludge sample data will serve as input to the soil disposal decision;

- composite soil sample data will serve as input to the soil disposal decision; and

- confirmation sampling data will serve as input for the delineation decision.

3.1.5 Step 4 – Define Boundaries of the Drum Removal Work Plan

The physical, temporal, and sample boundaries for the DRWP are summarized in this section.

The physical boundaries of the Site were discussed in Section 2.2 of the QAPP; the property is identified as Weld County parcel 146729400002. The operational boundaries within the Site property will include the areas of waste drum disposal as identified in the Phase 2 Nature and Extent Investigation at the Stratus Redtail Ranch, LLC, Erie Colorado report, and as updated and areas adjacent to the drum disposal location for the sorting and storage of drum and excavated soil until waste profile results.

Within the boundaries of the Site, scales of decision making will be established. These scales of decision making are the smallest appropriate subset of the population about which decisions pertaining to further action will be made (EPA, 1994). It is necessary to define a scale to be large enough to allow representative average values of chemical impacts yet small enough to avoid overlooking subareas with unusually high or unusually low impacts. Scales of decision making for the Site are described in the FSP. The buried drums and the soil surrounding the drums are examples of scales of decision-making; hence, they require characterization that is sufficient in each case.

Consideration of study boundaries includes temporal in addition to spatial boundaries. The duration of the DRWP field activities is anticipated to last approximately one month, although field activities will be conducted until the project objectives are met or a decision is made to otherwise modify the DRWP for the Site. The overall estimated project schedule is described in Section 7 of the DRWP.

3.1.6 Step 5 – Develop the Analytic Approach

Section 3.1.3, describes the goals that will be addressed by the sampling and analysis tasks of the DRWP.

For the three goals identified in Section 3.1.3, the following decision rules shall be applied:

- The waste drum data will be compared against Resource Conservation and Recovery Act (RCRA) hazardous waste characterization limits to develop an appropriate disposal scheme. If the results of the characterization indicate that the material is hazardous, then it will be disposed of as such. If the results of the

characterization indicate that the material are non-hazardous, then it will be disposed of in the appropriate manner at an EPA approved CERCLA facility.

- The soils data collected from the Site will be compared against RCRA hazardous waste characterization limits to develop an appropriate disposal scheme. If the results of the characterization indicate that the material is hazardous, then it will be disposed of as such. If the results of the characterization indicate that the material is non-hazardous, then it will be disposed of in the appropriate manner.

- The documented field observations and screening data will be compared against the criteria established in Section 4.2 of the DRWP to determine if the excavation was sufficient to support site removal goals. If the results of the field observations and screening indicate that the additional material needs to be excavated, then further excavation will occur. If the results indicate that additional material does not need to be excavated, then no further excavation will be required.

3.1.7 Step 6 – Specify Performance or Acceptance Criteria

3.1.7.1 Decision Problems

For the purposes of the DRWP, performance or acceptance criteria will be addressed without the need for statistical test designs as follows:

The usability of the data collected for the DRWP will be based on measurement activities consistent with accepted guidance documents such as SW846 Test Methods. The testing results will be evaluated against performance based acceptance criteria.

3.1.8 Step 7 – Develop a Detailed Plan for Obtaining Data

Details pertaining to the sampling design and procedures are contained in the FSP and in the DRWP. The sampling designs presented in these documents are selected based on the DQO process described herein to meet the project data quality objectives.

3.2 <u>Sampling Procedures for Field Activities</u>

3.2.1 Standard Operating Procedures and Waste Material Sampling

The FSP, a planning document that accompanies this QAPP, is written to present field sampling procedures in full detail. As such, this section of the QAPP only presents an

overview of field procedures that will be used to support the DRWP sampling will be limited to waste drum samples, soil and sludge samples from waste drum excavation area and soil confirmation samples. These samples will satisfy the waste assessment and disposal scheme development goals. Procedures for collecting liquid, solid and soil samples are described in detail in Sections 2.2 - 2.4 of the FSP.

If any circumstances arise that require deviation from SOPs, or the specifications of the FSP, Geosyntec will seek concurrence from the other contractors if they are on-site or can otherwise be reached. Whether or not the Contractor can be reached, Geosyntec will notify the EPA OSC promptly and document the change in the daily field notes.

3.2.2 Sample Containers, Preservation, and Storage

Sample containers will be furnished by the laboratory. For those samples that require preservation, preservatives will be added to the appropriate container by the laboratory prior to shipment of the containers. Containers and preservation and storage requirements for samples of different media are presented in Table 4.

Sample container cleaning procedures are documented by each laboratory in their quality assurance manual (QAM). The contractor and/or sampling personnel shall verify that the commercial supplier furnishes laboratory-grade, certified-clean containers. When bottle ware is shipped directly from the supplier to the field, a formal chain-of-custody is not normally initiated. In this instance, the airway bill receipt or packing slip serves as the initiation of the chain-of-custody.

3.2.3 Decontamination

Decontamination of sampling equipment will take place either at sampling locations or in a centralized area as needed. Equipment used for sampling will be decontaminated prior to each use and in accordance with the cleaning procedures described in the FSP and the applicable field SOP attached to the FSP.

3.2.4 Investigation Derived Waste

Solid and liquid waste will be tested for the RCRA TCLP waste profiling followed by disposal to the appropriate disposal facility, as needed. In such cases, waste will be managed according to USEPA's 1992 document "Guide to Management of Investigation-Derived Wastes." This document cites numerous applicable or relevant and appropriate requirements (ARARs), including certain definitions of hazardous waste (40 CFR

261.31-33), storage requirements for hazardous wastes (40 CFR 260.10), and DOT regulations for hazardous waste (49CFR100-199).

3.3 Sample Handling and Custody

3.3.1 Field Procedures

3.3.1.1 Hold Times

The first step in proper sample handling and custody is observance of analytical holding times, which can vary from 24 hours to one year depending upon the media and analytical method(s) selected for the samples. Knowledge of required holding times will have a direct impact on scheduling of sample collection, packing, and shipping activities. The sample container, volume, preservation, and holding times applicable to each analytical method are shown in Table 4 of this document.

3.3.1.2 Sample Custody

Sample collection and sample custody procedures are designed so that field custody of samples is maintained and documented. These procedures provide identification and documentation of the sampling event and the sample chain-of-custody from shipment of sample bottle ware, through sample collection, to receipt of the sample by the subcontracted laboratory. When used in conjunction with the laboratory's custody procedures and the sample bottle ware documentation, these data establish full legal custody and allow complete tracking of a sample from preparation and receipt of sample bottle ware to sample collection, preservation, and shipping through laboratory receipt, sample analysis and data validation. The chain-of-custody is defined as the sequence of persons who have the item in custody.

Field custody procedures are described below. Sample collection procedures concerning sample identification and documentation, field log book, sample containers, sample packing, and sample shipping are described.

The persons responsible for sample custody, and a brief description of their duties, are as follows:

- **Laboratory Sample Custodian or Commercial Supplier:** Verifies that the bottle ware is certified clean; arranges for bottle ware shipment to field sampling personnel.

- **Field Staff:** Receives sample bottle ware from laboratory, inspect bottle ware for physical integrity; retains shipping invoice or packing list from shipping courier as documentation of transfer of bottle ware; collects and preserves samples; retains bottle ware and samples under custody until sample shipment; relinquishes samples to shipping courier or to lab representative.

- **LPM:** Verifies reported laboratory analyses to the sample Chain-of-Custody Record; assures that chain-of-custody documentation is incorporated into the project file.

A sample or other physical evidence is in custody if it is/was:

- in the field investigator's, transferee's, or lab technician's actual possession;

- in the field investigator's, transferee's, or lab technician's view, after being in his/her physical possession;

- in the field investigator's, transferee's, or lab technician's physical possession and then he/she secured it to prevent tampering; or

- placed in a designated secure area.

3.3.1.3 Chain-of-Custody Record

The field Chain-of-Custody Record is used to record the custody of samples or other physical evidence collected and maintained. This form shall not be used to document the collection of split or duplicate samples. The Chain-of-Custody Record also serves as a sample logging mechanism for the analytical laboratories' sample custodian.

The following information must be supplied in the indicated spaces in detail to complete the field Chain-of-Custody Record:

- project specific information, including the project number and project name;

- the signatures of samplers and/or the sampling team leader in the designated signature block;

- the sampling location ID, date, and time of sample collection, grab or composite sample designation, and sample preservation type must be included on each line (each line shall contain only those samples collected at a specific location);

- the sampling team leader's name should be recorded in the right or left margin of the Chain-of-Custody Record when samples collected by more than one sampling team are included on the same form;

- the total number of sample containers must be listed in the indicated space for each sample and the total number of individual containers must also be listed for each type of analysis under the indicated media or miscellaneous columns (note that it is impossible to have more than one media type per sample);

- the field investigator and subsequent transferee(s) must document the transfer of the samples listed on the Chain-of-Custody Record in the spaces provided at the bottom of the form (both the person relinquishing the samples and the person receiving them must sign the form; provide the date and time that this occurred in the proper space on the form; and usually, the last person receiving the samples or evidence should be a laboratory sample custodian); and

- the remarks column at the bottom of the form is used to record air bill numbers or registered or certified mail serial numbers.

The Chain-of-Custody Record is a serialized document. Once the Record is completed, it becomes an accountable document and must be maintained in the project file. The suitability of any other form for chain-of-custody should be evaluated upon its inclusion of the above information in a legible format. Examples of Chain-of-Custody Records for each laboratory described in this document are provided as Attachment A.

3.3.1.4 Sample Identification and Documentation

Sample containers will be labeled with an identification number that uniquely identifies the sample. Sample identification numbering schemes are described in the FSP, Section 3. The sample identification number will be logged in the field log book or applicable sampling form as prescribed in the FSP, along with the following information about the sampling event:

- sampling personnel;

- date and time of collection;
- field sample location and depth, drum number etc. (as appropriate);
- observations on ambient conditions;
- type of sampling (composite or grab);
- method of sampling;
- sampling matrix or source;
- results of field screening;
- sample volume (for air analyses); and
- intended analyses.

3.3.1.5 Sample Packing and Shipping

Samples are packed for shipping in waterproof ice chests and coolers. Depending upon container type, the sample containers may be individually sealed in Ziploc or other similar plastic bags, prior to packing them in the cooler with bubble wrap or Styrofoam packing. Wet ice will be double-bagged in plastic bags (to inhibit cross contamination of samples by melt water) and placed with the samples in the cooler to maintain the samples at a temperature of 0-≤6 degrees Celsius (°C) during shipping.

The Chain-of-Custody Record that identifies the samples is signed as "relinquished" by the principal sampler or responsible party. This Chain-of-Custody Record is sealed in a waterproof plastic bag and is placed inside the cooler, typically by taping the bag to the inside lid of the cooler.

Following packing, the cooler lid is sealed with packing tape. A custody seal is signed, dated, and affixed from the cooler lid to the cooler body, and is additionally covered with clear tape. This ensures that tampering with the cooler contents will be immediately evident.

The sample coolers will be shipped by courier to the laboratory in accordance with laboratory schedule requirements. A copy of the shipping invoice is retained by the Field Manager and becomes part of the sample custody documentation.

3.3.2 Laboratory Procedures

The analytical laboratory named in this QAPP has an established program of sample custody that is designed to ensure that each sample is accounted for at all times. The objectives of the laboratory's sample custody program include:

- unique identification of the samples, as appropriate for the data required;
- analysis of the correct samples, and traceability to the appropriate records;
- preservation of sample characteristics;
- protection of samples from loss or damage;
- documentation of any sample alteration (e.g., filtration, preservation); and
- establishing a record of sample integrity for legal purposes.

The SOP for sample custody protocol is maintained by the laboratory and adhered to by laboratory personnel. The sample custody SOP is in the laboratory' SOP library and/or Quality Assurance Manual.

3.4 <u>Analytical Methods</u>

3.4.1 Introduction

Liquid and solid samples will be extracted/prepared and analyzed for organic and inorganic parameters by the methods specified in EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) (Tables 1a through 1c). SW-846 sample analysis methodologies will follow the laboratory SOPs specifically prepared for such samples or matrices. The QC limits for these analyses are shown in Tables 2a and 2b. Laboratory SOPs for these analyses are provided as Attachment B. Field analytical methods are presented in the FSP and the associated field SOPs.

The liquid waste drum samples will be analyzed for VOCs, SVOCs, RCRA eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), pesticides, herbicides, total polychlorinated biphenyls (PCBs), ignitability, corrosivity, and reactivity. The soil/sludge samples for waste characterization will be analyzed for ignitability, corrosivity, reactivity, and total PCBs as well as undergo TCLP extraction before being analyzed for VOCs, SVOCs, RCRA eight metals, herbicides and pesticides. The soil confirmation samples will be analyzed for ignitability, corrosivity, reactivity, and total PCBs as well as undergo TCLP extraction before being analyzed for VOCs, SVOCs, RCRA eight metals, herbicides and pesticides. Tables 1a through 1c summarize this information. Testing of total concentrations maybe substituted for TCLP where appropriate. Laboratory and field data gathering techniques are specified in the FSP and associated field SOPs for meeting the DQOs presented in Section 2.4 and Section 3.1. DQOs will be accomplished by conformance with a QA program, laboratory SOPs, and applicable regulatory requirements. Specific objectives are to:

- establish a protocol for estimating the quality of each analytical method;
- assist in early recognition of deficiencies affecting data quality;
- provide a system by which action can be taken to correct and document out-of-control conditions; and
- enhance data usefulness for reporting and decision-making by defining and documenting limitations on the quality of the data.

The QA program will provide the following: (i) traceable documentation of an adequate level of project records; (ii) verification that reports, and documentation are technically accurate; (iii) assurance of the availability of proper equipment that is correctly calibrated and used; and (iv) adherence to the scope of work. This section lists parameters to be evaluated in both the field and laboratory, quantitation limits to be achieved, and the analytical methodology to achieve these limits with necessary levels of control to produce data of known and desired quality.

3.4.2 Laboratory Methods

Parameters identified for laboratory analysis during the DRWP include inorganics and organics. The analytical laboratory that will analyze samples for this project will maintain

the appropriate state and federal certifications. Laboratory certification documents will be provided.

Consistent use of standard analytical methods throughout the project will allow comparability among the samples collected, and will achieve the DQOs for the project. Analytical methods to be used for this effort are SW-846 methods.

3.4.3 Required Detection Limits

Noted in Tables 1a through 1c are the Project Quantitation Limits (PQLs) or RLs associated with the previously described methods which will be utilized during the project. The limits represent the normally obtainable measurement level achieved and reported by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. The MDL is the minimum concentration that can be measured with 99% confidence that the analyte concentration is greater than zero in a given analytical procedure. Sample-specific RLs may vary from the standard PQL as a result of sample matrix and compound concentration. Samples with no positive results (down to the MDL) are typically flagged “U” (indicating “undetected”) by the laboratory. Positive results below the PQL but above the MDL are reported as estimated values by the laboratory.

Reported PQLs and MDLs will be adjusted for dilutions, as necessary, by the laboratory.

3.4.4 Field Methods

Procedures for utilizing field measurement devices are presented in the activity-specific FSP.

3.5. Quality Control

3.5.1 Introduction

A QC system is a set of internal procedures used by the field team and laboratory for assuring that the data output of a measurement system meets prescribed criteria for data quality. A well-designed internal QC program must be capable of controlling and measuring the quality of the data, in terms of precision and accuracy. Precision reflects the influence of the inherent variability in any measurement system, and accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter, and includes elements of both bias and precision.

This section addresses QC procedures associated with field sampling and analytical efforts. Included are general QC considerations as well as specific QC checks that provide ongoing control and assessment of data quality, in terms of precision and accuracy. Table 5 summarizes the requirements for the collection of QC samples in the field.

3.5.2 Field Quality Control Samples

3.5.2.1 Field Sampling

Field sampling procedures require the preparation and submittal of QC samples from the field:

- **Field Duplicates:** Two sets of samples from a source are prepared, labeled with unique sample numbers, and submitted to the laboratory without identifying the samples as duplicates. One field duplicate will be prepared for every 20 environmental samples collected for each matrix type.

- **Equipment Blanks:** Equipment blanks are prepared in the field to verify that a sampling device (e.g., trowel or auger) is free from contamination. A sampling device is rinsed with deionized water, and the rinsate is transferred to the appropriate sample bottles, preserved, and submitted to the laboratory for analysis. One equipment blank will be obtained for every 20 analytical samples and analyzed for the same constituents targeted in that day's sampling.

- **Trip Blanks:** Trip blank samples are prepared in the laboratory by filling a clean sampling container with reagent-grade deionized water. The sample is then taken to the site and handled with the other project samples and then submitted for analysis. One trip blank sample will be included in each container used to transport VOC samples to and from the laboratory. Trip blank samples will be analyzed for VOCs by EPA Method 8260C. Laboratory results of trip blank samples will be analyzed to assess potential contamination associated with sample handling and shipping.

The results of the analyses of these QC sample types are used as independent, external checks on laboratory and field contamination, as well as the precision of analyses.

3.5.3 Laboratory Quality Control

3.5.3.1 Method Blanks

A method (or preparation) blank is prepared at the frequency specified by the referenced method (typically one per analytical batch). The purpose of the method blank is to ensure that contaminants are not introduced by the glassware, reagents, standards, personnel, or the sample preparation environment.

For metal analyses, an instrument blank is also analyzed during each calibration shift to verify that contaminants are not being introduced by components of the instrumentation or analytical laboratory.

Various, routine QC checks are in place to verify that new lots of glassware, reagents and standards, decontaminated glassware, sample storage areas (including refrigerators), and water purification systems are contaminant-free.

3.5.3.2 Matrix Spikes and Matrix Spike Duplicates

An MS is a second, extra aliquot of an environmental sample to which known concentrations of target parameters have been added. The MS is carried through the entire analytical procedure, and the recovery of the analytes is calculated. Results are expressed as percent recovery. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

An MSD is a third, extra aliquot of an environmental sample that is also spiked with the same, known concentrations of analytes used for the MS. The two spiked aliquots are processed separately, and the results are compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as RPD and percent recovery.

One MS/MSD set will be analyzed for every 20 investigative samples. The MS/MSD will be site-specific and, therefore, field personnel will be responsible for collecting additional sample volumes to account for the MS/MSD samples. MS/MSD samples will be collected for soil only.

3.5.3.3 Laboratory Control Sample Recovery

LCSs are fortified with spike standard solutions containing target parameters of interest. The recovery of these standards is quantitatively measured during analysis, and historical records maintained on the percent recovery for each sample.

3.6. Preventive Maintenance

3.6.1 Laboratory Maintenance

Preventive maintenance is monitored in the laboratory by a system of log books kept for each instrument recording appropriate maintenance activities and schedules. Both daily and weekly tasks serve to maintain instrumentation in proper working order. Validation of optimal instrument performance by acceptable calibration and tuning criteria further support satisfactory data quality. Review of these logs and effective internal communications between QA/QC personnel allows for discovery and correction of problems.

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each piece of analytical instrument. Designated laboratory personnel are trained in routine maintenance procedures for major instrumentation. When repairs are necessary, they are performed by either trained staff or trained service engineers employed by the instrument manufacturer. Adherence to established calibration protocols allows for data comparability among data collected before and after required/preventative maintenance on analytical instruments. Descriptions of the laboratories' equipment and supplies are provided in Attachment B.

Each laboratory has detailed SOPs on file that describe preventive maintenance procedures and schedules. The SOPs and preventive maintenance schedules are presented in the laboratory-specific literature located in Attachment B. The laboratory shall also maintain detailed log books documenting the preventive maintenance and repairs performed on each analytical instrument.

3.7. Calibration Procedures and Frequency

3.7.1 Laboratory Procedures

Laboratory instruments will be calibrated according to the specified analytical methodology and manufacturer's instructions.

A critical element in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical operations. The preparation and maintenance of standards and reagents will be performed per the specified analytical method. The quality of reagents and standard solutions will be monitored through a series of well-documented procedures. Details regarding primary referenced standard sources and preparation of standard solutions are provided in each laboratory's SOPs located in Attachment B of this document.

Calibration of instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument will be calibrated with standard solutions appropriate to the type of instrument and the calibration range established for the given analytical method. The frequency of calibration and calibration verification and the concentration of calibration standards are determined by the manufacturer's guidelines and the analytical method. Details regarding instrument calibration and tuning by the laboratories are provided in the laboratories' literature in Attachment B.

3.8. Inspection/Acceptance for Supplies and Consumables

3.8.1 Field Supplies/Consumables

Critical field supplies and consumables include the following:

- sample bottle ware;
- decontamination fluids as described in the applicable SOP and FSP;
- personal protective equipment (PPE); and
- general sampling consumables (e.g., ice, plastic bags, paper towels, aluminum foil, etc.).

For bottle ware, the acceptance criteria will entail an inspection upon receipt of analytical testing to confirm the absence of cross-contamination as well as the presence of appropriate preservatives (e.g., HCl or HNO_3). For decontamination fluids, the field staff shall ensure that the fluids meet the necessary requirements for concentration and quality grade as applicable. PPE will be inspected to confirm integrity and ensure that the appropriate sizes are available as required by sampling team members.

3.8.2 Laboratory Supplies

The inspection and acceptance criteria for analytical reagents are provided in the laboratory SOPs provided in Attachment B.

3.9. Documentation/Data Management

3.9.1 Introduction

Documentation and data management are critical steps in maintaining quality during the DRWP activities. Documentation and data management begin with the development of appropriate field forms prior to field mobilization, continue with appropriate recordkeeping in the field, and conclude with thorough records management and database population after the work has been completed. The following sections describe these steps in greater detail.

3.9.2 Field Log Book and Forms

Field visits and sample collection programs are documented using a combination of field log books and specific field log forms. These two methods have their advantages and disadvantages, as follows:

- Field log books have the advantage of maintaining work chronology. Since pages and lines are used in sequence without any skips, it is possible to reconstruct the sequence of work in the event that any quality issues or other incidents arise. One log book can be used to document several weeks' worth of work in sequence, depending upon the nature of the work. In addition, since log books lack structure, they provide flexibility, in that they can be used to document nearly any site work. However, the lack of structure in log books is a disadvantage for record-intensive work, such as groundwater sampling, because the lack of entry boxes for field parameters discourages consistent data collection.

- Conversely, field forms have the advantage of customization (e.g., a groundwater sampling form can be designed in detail to remind the field team member to record a list of specific readings). Field forms are valuable for large sampling events in which consistency in the method of recording observations is desired. They have the disadvantage of lacking weatherproofing or any degree of chronological sequence. They are also not as portable or durable as log books.

A log book will be in use for visits to the Site, ranging from brief site walks to major, multi-week removal actions. If the work is short in duration (e.g., less than one day) and irregular or *ad hoc* in nature (i.e., a task that is not captured by a standard field form), then the work shall be documented in the log book. Conversely, if the site visit is longer in duration and more repetitive (e.g., a major bulk solid or soil sampling event), corresponding field forms will be used for documentation of each sample, whereas the log book will be used to document a summary of the day's activities and non-repetitive tasks, including the following:

- time of arrival and departure from the Site, including lunch breaks;
- names of field team members;
- time of arrival and departure of subcontractors;
- the nature of the daily health and safety tailgate meeting, with signatures of participants;
- supply deliveries;
- weather;
- interaction with agency or client personnel;
- incident occurrence and management; and
- any other irregular or *ad hoc* activities.

As such, the log book(s) will provide a comprehensive overview of site activities throughout the DRWP; the level of detail of documentation within each log book entry will depend upon the duration of an individual visit and the applicability of field forms to the tasks performed.

Data collected during buried drum sampling will be recorded in the log book including, at a minimum, the following information: Date, time and location of sampling; visual description of drum, label (if present) and sample; investigators performing the task; type of equipment used to collect sample; and any other pertinent observations

Data collected during soil sampling for presumed hazardous and for presumed non-hazardous waste will be recorded in the log book including, at a minimum, the following information: Date, time and location of sampling; visual description of sample; investigators performing the task; type of equipment used to collect sample; weather conditions during sampling; and any other pertinent observations.

Data collected during soil confirmation sampling will be recorded in the log book including, at a minimum, the following information: Date, time and location of sampling; visual description of sample; investigators performing the task; type of equipment used to collect sample; and any other pertinent observations.

3.9.3 Details of Log Book Use

Sampling personnel will use a bound field log book with moisture resistant-pages to record pertinent field information with waterproof ink. The log book will identify the project name, project number, and geographic location of the site; it will also indicate the name and mobile telephone number of the Field Manager in the event that the log book is lost and recovered. Daily field activities and sampling information will be entered in the log book on serially-numbered pages. At the end of each day's entries, sample collection personnel shall sign and date the entry. Corrections will be made to entries with initialed and dated line-out deletions. A diagonal line will be drawn across the remaining blank space of the last page of each day's entry. Log book lines will be used in sequence, and no blank lines shall remain at the end of the day. Observations will be recorded in sequence.

Multiple log books may be required over the course of the DRWP. It is desirable to have a continuous sequence of log books throughout the course of the project, with one log book in use at any one time. Upon completion of a log book, the timeframe covered will be clearly indicated on the front cover and spine by noting the date range of work and investigative phase name. In some cases, however, the presence of multiple field teams may require the use of two log books in parallel. In these cases, the Field Manager shall maintain the primary log book. The secondary log book shall be clearly identified as such and shall make reference to the primary log book on or inside its front cover. It shall only be used to record observations made away from the Field Manager.

3.9.4 Field Forms

As discussed in Section 3.10.2, field forms shall be used for specific field sampling tasks of a routine and repetitive nature, such as buried drum and soil sampling. Field forms have the advantage of prompting the user for detailed data documentation in a consistent format.

Attachment C includes field form templates for buried drum and soil sampling and daily field reports.

The protocol for form completion will be similar to those of log books:

- one form will be filled out per sample;
- corrections shall be made through single-line strikeout with initial and date; and
- tables within forms (e.g., soil boring log) shall be filled out with each line in sequence; no lines will be skipped, and unused lines at the end of sample collection shall be crossed out, initialed, and dated.

3.9.5 Electronic Data Management

Data management for the DRWP is governed by Region 8 specifications as indicated in EPA Region 8 Quality Management Plan, December 2012. These specifications indicate a standardized database schema for electronic data reporting to the consultant, entry into the site database, and delivery to EPA Region 8 with data reports.

4. ASSESSMENT AND OVERSIGHT

4.1 Assessments and Response Actions

4.1.1 Introduction

The QA Manager may conduct both performance and systems audits of both field and laboratory activities, as necessary. Following is a discussion of types of audits.

4.1.2 Systems Audit

A systems audit consists of the evaluation of key components of the measurement systems to determine their proper selection and use. This audit includes a careful evaluation of both field and laboratory QC procedures. When required by EPA or alternative regulatory authority, systems audits are performed prior to or shortly after systems are operational.

4.1.2.1 Field Systems Audits

This on-site audit focuses on data collection systems, using this QAPP as a reference. Specific activities vary with the scope of the audit, but can include a review of the following:

- sample collection activities;
- equipment calibration techniques and records;
- decontamination and equipment cleaning;
- background and training of personnel;
- sample containers and preservation techniques; and
- chain-of-custody procedures.

4.1.2.2 Laboratory Systems Audit

The laboratory systems audit is a review of laboratory operations to verify that the laboratory has the necessary facilities, equipment, staff, and procedures in place to generate acceptable data.

Specific activities vary with the scope of the audit, but can include a review of the following:

- equipment suitability and maintenance/repair;
- background and training of personnel;
- laboratory control charts and support systems;
- QA samples, including performance evaluation samples;
- chain-of-custody procedures; and
- data logs, data transfer, data reduction, and validation.

4.1.3 Performance Audits

After systems are operational and generating data, EPA may request that a performance audit be conducted to determine the accuracy of the total measurement system(s) or component parts thereof.

4.1.3.1 Laboratory Performance Audits

The project laboratories participate in a variety of federal and state programs that subject laboratories to stringent performance audits on a regular basis. QA policies and procedures currently in place at the laboratories, and actions that will be included in sampling activities to ensure QA, include the following:

- both intra-laboratory and inter-laboratory check samples;
- periodic (at least annual) audits conducted by the Corporate QA Office; and
- laboratory control samples analyzed at a frequency equal to at least 10 percent of the total number of samples analyzed; and

EPA laboratory performance in these areas will be monitored by the Geosyntec QA manager. If necessary, or at the request of the EPA OSC, the Geosyntec QA manager will conduct an on-site audit of field operations or any of these laboratories at a frequency of no more than once per year per laboratory or once per major sampling event.

4.1.3.2 Field Performance Audit

Performance audits of field screening and sampling activities shall be conducted using a review of laboratory sample receipt forms.

An inspection for suitability of the samples for proper laboratory analysis serves as the performance audit of the sample collection procedures. Volatiles possessing free air (i.e., a bubble in an aqueous sample vial), insufficient sample volume for analysis, or improper preservation of samples will be noted by the analytical laboratory. A preponderance of such reports of unsuitable samples will indicate that the sampling procedures are poor or unacceptable. Analytical results will be reviewed by the Project Manager and the QA Manager to assess the performance and adequacy of sample collection procedures.

4.1.4 Corrective Action for Measurement Systems

When a problem situation arises regarding any significant impediment to the progress of the DRWP, corrective action will be implemented to identify the problem and its source. Appropriate documentation of this action will be recorded in the project file.

Personnel responsible for the initiation and approval of corrective action will be the laboratory QA Manager (for corrective action at the laboratory) and the QA Manager (for corrective actions identified during field activities and/or during the data validation effort). Geosyntec's Project Manager will be responsible for the approval of corrective action measures.

4.1.4.1 Laboratory Corrective Action and Response

When the analysis of any sample indicates the system may be out of control, a QC check sample is analyzed. If the analysis of the check sample indicates a problem, the Laboratory Manager is notified, and corrective action is implemented. This corrective action includes, but is not limited to the following:

- removal of the instrument from service;
- isolation of the source of the problem;
- correction of the problem; or
- reanalysis of the check sample.

The instrument cannot be put back into service until the check sample meets QA specifications. Also, the Group Leader must sign the maintenance log book and enter the information related to the check sample.

To minimize the chances for an out-of-control situation to occur, the laboratory will be provided feedback on performance evaluations in a timely manner.

4.1.4.2 Field Measurement Corrective Action and Response

Technical staff and project personnel will be responsible for reporting of suspected technical or QA nonconformance's or suspected deficiencies of any activity or issued document by reporting the situation to the Field Manager. This supervisor will be responsible for assessing the suspected problems in consultation with the Project QA Manager and making a decision based on the potential for the situation to impact the quality of the data. If it is determined that the situation indicates a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the Field Manager.

The Field Manager will be responsible for ensuring that corrective action for nonconformance's is initiated by:

- evaluating reported nonconformance's;
- controlling additional work on nonconforming items;
- determining disposition or action to be taken;
- maintaining a log of nonconformance's;
- reviewing nonconformance reports and corrective actions taken; and
- ensuring nonconformance reports are included in the final site documentation in project files.

If appropriate, the Field Manager will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective actions for field measurements may include:

- repeating measurements to check the error;
- checking for proper adjustments for ambient conditions such as temperature;
- checking the batteries;
- recalibrating;
- checking the calibration;
- replacing the instrument measuring devices; and
- stopping work (if necessary).

The Field Manager or designee is responsible for site activities. In this role, the Field Manager at times is required to adjust the site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the Field Manager of the anticipated change and implements the necessary changes after obtaining the approval of the Field Manager.

Corrective actions will be implemented and documented in the field log book. No staff member will initiate corrective action without prior communication of findings through the Field Manager.

4.2 Quality Assurance Reporting Procedures

Presented below are the QA reporting procedures that will be implemented for this project.

4.2.1 Reporting Responsibility and Recordkeeping

Comprehensive records shall be maintained by Geosyntec to provide evidence of QA activities.

These records shall include the following documentation:

- results of performance and systems audits;
- data validation summary reports;

- significant QA problems and proposed corrective action; and
- changes to this QAPP.

The proper maintenance of QA records is essential to provide support in any evidentiary proceedings. The original QA records will be kept in the program QA/QC manager's records.

Access to working files will be restricted to project personnel. Upon termination of an individual task or work assignment, working files will be processed for storage as QA.

4.2.2 Monthly Progress Reports

Descriptions of completed tasks will be forwarded to the EPA OSC as part of the monthly progress report for the Site.

4.2.3 Audit Reports

Should audits be requested by EPA, the corresponding audit reports will be distributed to the following project personnel, as appropriate.

- Project Manager/Project Coordinator;
- Field Manager; and
- Laboratory QA/QC Manager.

5. DATA QUALITY ASSESSMENT

Section 5 addresses the stages of data quality assessment after data have been received. It addresses data reduction, review, verification, and validation. It also sets procedures for evaluating the usability of data with respect to the DQOs set forth in Section 3.

5.1 Data Reduction, Review, Verification, and Validation

5.1.1 Data Reduction

Raw analytical data generated in the laboratory are collected on printouts from the instruments and associated data system or are manually recorded into bound notebooks. Analysts review data as they are generated to determine that the instruments are performing within specifications. This review includes calibration checks, surrogate recoveries, blank checks, retention time reproducibility, and other QC checks as specified in the SOPs. If any problems are noted during the analytical run, corrective action is taken and documented.

5.1.2 Data Review

Data review is an initial and relatively non-technical step of data assessment that primarily addresses issues of completeness and data handling integrity. In data review, the reviewer will ensure that the necessary reporting components have been included in laboratory reports, such as necessary fields (e.g., collection/analysis dates, units, etc.) as well as the presence of (but not implications of) QA/QC data components (e.g., LCS records, surrogate results, etc.).

5.1.3 Data Verification and Validation

Data verification is a more technical process than data review in that the core technical aspects of data quality (e.g., precision, accuracy, etc.) are evaluated through a review of the results of QA/QC measures, such as LCSs and surrogates.

Following interpretation and data reduction by an analyst, data are transferred to the laboratory sample management system either by direct data upload from the analytical data system or manually. The data are reviewed by the group leader or another analyst and marked on the sample management system as being verified. The person performing the verification reviews the data including QC information prior to verifying the data. If data package deliverables have been requested, the laboratory will complete the

appropriate forms summarizing the QC information and transfer copies of the raw data (e.g., instrument printouts, spectra, chromatograms, etc.) to the Data Packages Group. This group will combine the information from the various analytical groups and the analytical reports from the laboratory sample management system into one package. This package is reviewed by the LPM for conformance with SOPs and to ensure that project QC goals have been met. Any analytical problems are discussed in the case narrative, which is also included with the data package deliverables.

Following data verification by the laboratory, data validation will be conducted. Stage 2A data validation will be conducted on 100% of the laboratory data by Geosyntec's data validation team. This validation may be done on hard copy data or performed electronically, if applicable. The National Functional Guidelines for Inorganic Superfund Data Review, January 2017 will be used as the basis for the validation of inorganic data. The National Functional Guidelines for Superfund Organic Methods Data Review, January 2017, will be used as the basis for the review of organic data as well as any Regional EPA validation guidance that may be pertinent. These guidance documents provide structured approaches for the assignment of data qualifiers based on observations made in the data verification process and will be used in conjunction with the specific EPA method specified criteria, as well as the QA criteria set forth in the project-specific FSP.

5.1.4 Data Validation and Usability Determination

While data verification is a technical process in which the data's adherence to core PARCCS elements is evaluated, it still does not answer the final question of the usability of the data and the implications of any departures from data expectations. The data validation process is designed to answer these questions through: (i) the assignment of data qualifiers based on the data verification results; and (ii) a case-by-case review of data quality issues with respect to QAPP objectives to render a final assessment of data usability.

The final step of data evaluation entails a comparison of data quality performance with the QAPP-specific DQOs. Section 3 of this QAPP discusses the DRWP objectives, which include cases of estimation problems (e.g., quantitative risk assessment) and decision problems (e.g., waste profiling or background assessment). In cases of estimation (e.g., exposure point concentrations), it is desirable, in abstract terms, to develop the "best" exposure point estimate possible, because the resulting data use is the most rigorous. In

such cases, data validation will adhere to the established data validation guidance documents cited above.

5.2 Data Evaluation Roles and Responsibilities

The following components of data evaluation will be performed by certain entities as noted:

- data reduction will be performed by the analytical laboratory;
- data review will be performed both by the laboratory and by Geosyntec;
- data verification will be performed both by the laboratory and by Geosyntec; and
- data validation and usability determination will be performed by Geosyntec.

5.3 Data Reporting

Laboratory reports will contain the following:

- **Case Narrative:** Description of sample types, tests performed, any problems encountered, corrective actions taken, and general comments are given.
- **Analytical Data:** Data are reported by sample or by test. Pertinent information such as dates sampled, received, prepared and extracted is included on each results page. The reporting limit for each analyte is also given. In addition to a hardcopy, both laboratories shall provide an electronic data deliverable (EDD) in a text format corresponding to each analytical report. Specific codes and data forms have been developed to allow consistent and efficient input of information. The EDD is checked for completeness by the "Electronic Laboratory Data Checker (ELDC)" program prior to submittal to the client. The ELDC program will issue an "errors" report indicating the deliverable is incomplete or incorrect if anomalies are detected. Based on the errors report, the laboratory will complete the submittal and issue a "final" EDD.
- **Laboratory Performance QC Information:** The results (Percent Recovery and RPD) of the LCSs analyzed with the project are listed, together with the control

limits. Also, the analytical results for method blanks generated during analysis of organic and metals parameters are given.

- **Matrix-Specific QC Information:** Results of any sample duplicates, MSs, MSDs, or other project-specific QC measures that are requested are reported.
- **Methodology:** The reference for the applied analytical methodology is cited.
- **Custom Services:** Special services including data interpretation, special consultation, and raw data packages are provided (when requested).

The reporting scheme from collection of raw data through document storage is as follows:

- raw data collected by laboratory technical personnel;
- data reviewed/checked by laboratory supervisor;
- data receive QA/QC review and approval from the Project Manager;
- written report, with accompanying QC data, undergoes data validation as needed; validator qualifier codes are incorporated into the EDD (with follow-up QC check). The EDD is checked against the hardcopy results during the validation process. Minor errors are corrected in-house. Resubmittal of the hardcopy or the EDD may be required if major errors are observed;
- if data are accepted by contractor, then a data assessment summary report is prepared; and
- if data are not accepted by contractor, then corrective action procedures are implemented, and the data review process is reinitiated.

Data summary report, including data validation review and laboratory QA/QC deliverables, is presented to EPA.

6. REFERENCES

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TABLES

Table 1a. Project Action Limits and Analytical Quantitation Limits for Chemicals of Potential Concern in Liquid Waste Samples
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Parameter	Chemical Abstract Service (CAS) Number	Method	Project Action Limits (µg/L)	Project Quantitation Limits * (µg/L)	Achievable Laboratory MDLs* (µg/L)
Metals					
Arsenic	7440-38-2	6010C	5,000	1,000	277
Barium	7440-39-3	6010C	100,000	20,000	1,070
Cadmium	7440-43-9	6010C	1,000	500	36.4
Chromium	7440-48-4	6010C	5,000	500	123
Lead	7439-92-1	6010C	5,000	1,000	247
Selenium	7782-49-2	6020A	1,000	1,000	516
Silver	7440-22-4	6020A	5,000	500	105
Mercury	7439-97-6	7471B	200	33	7.39
VOCs					
1,1-Dichloroethene	75-35-4	8260C	700	250	143
1,2-Dichloroethane	107-06-2	8260C	500	250	72.6
Benzene	71-43-2	8260C	500	250	98.1
Carbon Tetrachloride	56-23-5	8260C	500	250	160
Chlorobenzene	108-90-7	8260C	100,000	250	78.7
Chloroform	67-66-3	8260C	6,000	250	106
Methyl Ethyl Ketone	78-93-3	8260C	200,000	250	145
Tetrachloroethene	127-18-4	8260C	700	250	100
Trichloroethene	79-01-6	8260C	500	250	75.1
Vinyl Chloride	75-01-4	8260C	200		
SVOCs					
1,4-Dichlorobenzene	106-46-7	8270D	7,500	10,000	685
2,4-Dinitrotoluene	121-14-2	8270D	130	10,000	1,330
2,4,5-Trichlorophenol	95-95-4	8270D	400,000	10,000	952
2,4,6-Trichlorophenol	88-06-02	8270D	2,000	10,000	877
2-Methylphenol (Cresol, o-)	95-48-7	8270D	200,000	10,000	884
3-Methylphenol (Cresol, m-)	108-39-4	8270D	200,000	10,000	886
4-Methylphenol (Cresol, p-)	106-44-5	8270D	200,000	10,000	886
Hexachlorobenzene	118-74-1	8270D	130	2,000	806
Hexachlorobutadiene	87-68-3	8270D	500	2,000	631
Hexachloroethane	67-72-1	8270D	3,000	10,000	718
Nitrobenzene	98-95-3	8270D	2,000	20,000	765
Pentachlorophenol	87-86-5	8270D	100,000	50,000	18,900
Pyridine	110-86-1	8270D	5,000	10,000	958
OCPs					
Chlordane	57-74-9	8081B	30.0	500	60
Endrin	72-20-8	8081B	20.0	50	9.12
Heptachlor (and its Epoxide)	76-44-8	8081B	8.0	50	18.1
Lindane	58-89-9	8081B	400	50	4.76
Methoxychlor	72-43-5	8081B	10,000	50	13.8
Toxaphene	8001-35-2	8081B	500	4,000	452
Herbicides					
2,4-D	94-75-7	8150B	10,000	4,000	653
2,4,5-TP (Silvex)	93-72-1	8150B	1,000	1,000	166
PCBs					
Total PCBs	1336-36-3	8082A	50,000	500	396
Cyanide					
Total cyanide	57-12-5	9012B	10000	500	153
Sulfide					
Sulfide	18496-25-8	9034	10000	40,000	20,000
Ignitablility					
Ignitablility	NA	1010A	>140 °F	1	NA
pH					
pH	NA	9045	2<pH<12.5	0.1	NA

Notes:
1. Project Action Limits are based on 40 CFR §261.24 (Maximum Concentration of Contaminants for the Toxicy Characteristic)
 * Analytical results will be determined on a mass basis (µg/kg) using Method 3580A Waste Dilution and converted to a volumetric basis (µg/L) using sample density
2. MDL: Method Detection Limit
3. µg/L: Micrograms per liter
3. VOC: Volatile Organic Compound
4. SVOC: Semi-Volatile Organic Compound
5. OCP: Organochlorine Pesticides

Table 1b. Project Action Limits and Analytical Quantitation Limits for Chemicals of Potential Soil/Sludge Samples for Waste Profile Characterization
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Parameter	Chemcial Abstract Service (CAS) Number	Method	Project Action Limits (µg/L)	Project Quantitation Limits (µg/L)	Achievable Laboratory MDLs (µg/L)
Parameter	**Chemical Abstract**	**Method**	**Project Action**	**Project**	**Achievable**
TCLP Metals					
Arsenic	7440-38-2	6010C	5,000	50	4.11
Barium	7440-39-3	6010C	100,000	200	11.2
Cadmium	7440-43-9	6010C	1,000	50	0.164
Chromium	7440-48-4	6010C	5,000	50	0.782
Lead	7439-92-1	6010C	5,000	50	2.85
Selenium	7782-49-2	6010C	1,000	50	3.63
Silver	7440-22-4	6010C	5,000	50	0.85
Mercury	7439-97-6	7470A	200	0.2	0.065
TCLP VOCs					
1,1-Dichloroethene	75-35-4	8260C	700	200	114
1,2-Dichloroethane	107-06-2	8260C	500	200	58.1
Benzene	71-43-2	8260C	500	200	78.5
Carbon Tetrachloride	56-23-5	8260C	500	200	133
Chlorobenzene	108-90-7	8260C	100,000	200	63
Chloroform	67-66-3	8260C	6,000	200	84.5
Methyl Ethyl Ketone	78-93-3	8260C	200,000	200	116
Tetrachloroethene	127-18-4	8260C	700	200	80
Trichloroethene	79-01-6	8260C	500	200	60.1
Vinyl Chloride	75-01-4	8260C	200	200	147
TCLP SVOCs					
1,4-Dichlorobenzene	106-46-7	8270D	7,500	50	4.51
2,4-Dinitrotoluene	121-14-2	8270D	130	50	7.9
2,4,5-Trichlorophenol	95-95-4	8270D	400,000	50	7.92
2,4,6-Trichlorophenol	88-06-02	8270D	2,000	50	9.45
2-Methylphenol (Cresol, o-)	95-48-7	8270D	200,000	50	4.03
3-Methylphenol (Cresol, m-)	108-39-4	8270D	200,000	50	7.87
4-Methylphenol (Cresol, p-)	106-44-5	8270D	200,000	50	7.87
Hexachlorobenzene	118-74-1	8270D	130	50	5.47
Hexachlorobutadiene	87-68-3	8270D	500	50	8.37
Hexachloroethane	67-72-1	8270D	3,000	50	4.02
Nitrobenzene	98-95-3	8270D	2,000	50	1.22
Pentachlorophenol	87-86-5	8270D	100,000	250	7.54
Pyridine	110-86-1	8270D	5,000	100	8.15
TCLP OCPs					
Chlordane	57-74-9	8081B	30.0	5	0.6
Endrin	72-20-8	8081B	20.0	5	0.09
Heptachlor (and its Epoxide)	76-44-8	8081B	8.0	5	1.8
Lindane	58-89-9	8081B	400	5	0.047
Methoxychlor	72-43-5	8081B	10,000	5	1.38
Toxaphene	8001-35-2	8081B	500	40	4.52
TCLP Herbicides					
2,4-D	94-75-7	8150B	10,000	40	4.53
2,4,5-TP (Silvex)	93-72-1	8150B	1,000	10	1.07
PCBs					
Total PCBs	1336-36-3	8082A	50,000	500	396
Cyanide					
Total cyanide	57-12-5	9012B	10,000	500	153
Sulfide					
Sulfide	18496-25-8	9034	10,000	300	100
Ignitablility					
Ignitablility	NA	SW 846 7.1.2	>140 °F	1	NA
pH					
pH	NA	9045	2<pH<12.5	0.1	NA

Notes:
1. Project Action Limits are based on 40 CFR §261.24 (Maximum Concentration of Contaminants for the Toxicy Characteristic)
2. MDL: Method Detection Limit
3. µg/L: Micrograms per liter
3. VOC: Volatile Organic Compound
4. SVOC: Semi-Volatile Organic Compound
5. OCP: Organochlorine Pesticides

Table 1c. Project Action Limits and Analytical Quantitation Limits for Chemicals of Concern in Soil Confirmation Samples
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Parameter	Chemcial Abstract Service (CAS) Number	Method	Project Action Limits (µg/L)	Project Quantitation Limits (µg/L)	Achievable Laboratory MDLs (µg/L)
Parameter	**Chemcial Abstract**	**Method**	**Project Action**	**Project**	**Achievable**
TCLP Metals					
Arsenic	7440-38-2	6010C	5,000	50	4.11
Barium	7440-39-3	6010C	100,000	200	11.2
Cadmium	7440-43-9	6010C	1,000	50	0.164
Chromium	7440-48-4	6010C	5,000	50	0.782
Lead	7439-92-1	6010C	5,000	50	2.85
Selenium	7782-49-2	6010C	1,000	50	3.63
Silver	7440-22-4	6010C	5,000	50	0.85
Mercury	7439-97-6	7470A	200	0.2	0.065
TCLP VOCs					
1,1-Dichloroethene	75-35-4	8260C	700	200	114
1,2-Dichloroethane	107-06-2	8260C	500	200	58.1
Benzene	71-43-2	8260C	500	200	78.5
Carbon Tetrachloride	56-23-5	8260C	500	200	133
Chlorobenzene	108-90-7	8260C	100,000	200	63
Chloroform	67-66-3	8260C	6,000	200	84.5
Methyl Ethyl Ketone	78-93-3	8260C	200,000	200	116
Tetrachloroethene	127-18-4	8260C	700	200	80
Trichloroethene	79-01-6	8260C	500	200	60.1
Vinyl Chloride	75-01-4	8260C	200	200	147
TCLP SVOCs					
1,4-Dichlorobenzene	106-46-7	8270D	7,500	50	4.51
2,4-Dinitrotoluene	121-14-2	8270D	130	50	7.9
2,4,5-Trichlorophenol	95-95-4	8270D	400,000	50	7.92
2,4,6-Trichlorophenol	88-06-02	8270D	2,000	50	9.45
2-Methylphenol (Cresol, o-)	95-48-7	8270D	200,000	50	4.03
3-Methylphenol (Cresol, m-)	108-39-4	8270D	200,000	50	7.87
4-Methylphenol (Cresol, p-)	106-44-5	8270D	200,000	50	7.87
Hexachlorobenzene	118-74-1	8270D	130	50	5.47
Hexachlorobutadiene	87-68-3	8270D	500	50	8.37
Hexachloroethane	67-72-1	8270D	3,000	50	4.02
Nitrobenzene	98-95-3	8270D	2,000	50	1.22
Pentachlorophenol	87-86-5	8270D	100,000	250	7.54
Pyridine	110-86-1	8270D	5,000	100	8.15
TCLP OCPs					
Chlordane	57-74-9	8081B	30.0	5	0.6
Endrin	72-20-8	8081B	20.0	5	0.09
Heptachlor (and its Epoxide)	76-44-8	8081B	8.0	5	1.8
Lindane	58-89-9	8081B	400	5	0.047
Methoxychlor	72-43-5	8081B	10,000	5	1.38
Toxaphene	8001-35-2	8081B	500	40	4.52
TCLP Herbicides					
2,4-D	94-75-7	8150B	10,000	40	4.53
2,4,5-TP (Silvex)	93-72-1	8150B	1,000	10	1.07
Cyanide					
Total cyanide	57-12-5	9012B	10000	500	153
Sulfide					
Sulfide	18496-25-8	9034	10000	300	100
Ignitablility					
Ignitablility	NA	SW846 7.1.2	>140 °F	1	NA
pH					
pH	NA	9045	2<pH<12.5	0.1	NA

Notes:
1. Project Action Limits are based on 40 CFR §261.24 (Maximum Concentration of Contaminants for the Toxicy Characteristic)
2. MDL: Method Detection Limit
3. µg/L: Micrograms per liter
3. VOC: Volatile Organic Compound
4. SVOC: Semi-Volatile Organic Compound
5. OCP: Organochlorine Pesticides

Table 2a. Quality Assurance Objectives for Laboratory Parameters for Liquid Waste Samples
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Laboratory Control Spike/Laboratory Control Spike Duplicate, Matrix Spike/Matrix Spike Duplicate, Field Duplicate									
Parameter	**CAS Number**	**LCS/LCSD Percent Recovery**			**LCS/LCSD RPD**	**MS/MSD Percent Recovery**			**MS/MSD and FD RPD**
Metals									
Arsenic	7440-38-2	80	–	120	20	50	–	150	50
Barium	7440-39-3	80	–	120	20	50	–	150	50
Cadmium	7440-43-9	80	–	120	20	50	–	150	50
Chromium	7440-48-4	80	–	120	20	50	–	150	50
Lead	7439-92-1	80	–	120	20	50	–	150	50
Selenium	7782-49-2	80	–	120	20	50	–	150	50
Silver	7440-22-4	80	–	120	20	50	–	150	50
Mercury	7439-97-6	80	–	120	20	50	–	150	50
VOCs									
1,1-Dichloroethene	75-35-4	62	–	127	19	50	–	150	50
1,2-Dichloroethane	107-06-2	65	–	131	15	50	–	150	50
Benzene	71-43-2	74	–	117	15	50	–	150	50
Carbon Tetrachloride	56-23-5	63	–	134	21	50	–	150	50
Chlorobenzene	108-90-7	77	–	117	15	50	–	150	50
Chloroform	67-66-3	70	–	122	15	50	–	150	50
Methyl Ethyl Ketone	78-93-3	29	–	150	40	50	–	150	50
Tetrachloroethene	127-18-4	77	–	118	18	50	–	150	50
Trichloroethene	79-01-6	75	–	121	15	50	–	150	50
Vinyl Chloride	75-01-4	41	–	142	40	50	–	150	50
SVOCs									
1,4-Dichlorobenzene	106-46-7	56	–	115	23	50	–	150	50
2,4-Dinitrotoluene	121-14-2	55	–	112	24	50	–	150	50
2,4,5-Trichlorophenol	95-95-4	47	–	117	21	50	–	150	50
2,4,6-Trichlorophenol	88-06-02	45	–	127	24	50	–	150	50
2-Methylphenol (Cresol, o-)*	95-48-7	55	–	109	27	50	–	150	50
3-Methylphenol (Cresol, m-)*	108-39-4	51	–	106	24	50	–	150	50
4-Methylphenol (Cresol, p-)*	106-44-5	51	–	106	24	50	–	150	50
Hexachlorobenzene	118-74-1	43	–	128	25	50	–	150	50
Hexachlorobutadiene	87-68-3	36	–	140	22	50	–	150	50
Hexachloroethane	67-72-1	53	–	115	25	50	–	150	50
Nitrobenzene	98-95-3	49	–	127	24	50	–	150	50
Pentachlorophenol	87-86-5	40	–	124	29	50	–	150	50
Pyridine	110-86-1	42	–	150	50	50	–	150	50
OPCs									
Chlordane	57-74-9	40	–	130	35	50	–	150	50
Endrin	72-20-8	45	–	129	32	50	–	150	50
Heptachlor (and its Epoxide)	76-44-8	53	–	125	35	50	–	150	50
Lindane	58-89-9	48	–	124	33	50	–	150	50
Methoxychlor	72-43-5	57	–	117	23	50	–	150	50
Toxaphene	8001-35-2	40	–	130	50	50	–	150	50
Herbicides									
2,4-D	94-75-7	17	–	100	40	50	–	150	50
2,4,5-TP (Silvex)	93-72-1	36	–	109	40	50	–	150	50
PCBs									
Total PCBs	1336-36-3	35	–	136	24	50	–	150	50
Cyanide									
Total cyanide	57-12-5	38	–	162	20	50	–	150	50
Sulfide									
Sulfide	18496-25-8	80	–	120	20	50	–	150	50
Ignitablility									
Ignitablility	NA	96	–	103	20	NA		NA	NA
pH									
pH	NA	99	–	101	2	NA		NA	NA

RPD-relative percent difference
OPC-Organochlorine Pesticides
SVOC-semivolatile organic compounds
VOC-volatile organic compounds
CAS - chenical abstract service
FD-field duplicate

Table 2b. Quality Assurance Objectives for Laboratory Parameters for Soil / Sludge samples
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Laboratory Control Spike/Laboratory Control Spike Duplicate, Matrix Spike/Matrix Spike Duplicate, Field Duplicate									
Parameter	**CAS Number**	**LCS/LCSD Percent Recovery**			**LCS/LCSD RPD**	**MS/MSD Percent Recovery**			**MS/MSD and FD RPD**
Metals									
Arsenic	7440-38-2	80	–	120	20	50	–	150	50
Barium	7440-39-3	80	–	120	20	50	–	150	50
Cadmium	7440-43-9	80	–	120	20	50	–	150	50
Chromium	7440-48-4	80	–	120	20	50	–	150	50
Lead	7439-92-1	80	–	120	20	50	–	150	50
Selenium	7782-49-2	80	–	120	20	50	–	150	50
Silver	7440-22-4	80	–	120	20	50	–	150	50
Mercury	7439-97-6	80	–	120	20	50	–	150	50
VOCs									
1,1-Dichloroethene	75-35-4	59	–	128	17	50	–	150	50
1,2-Dichloroethane	107-06-2	67	–	123	15	50	–	150	50
Benzene	71-43-2	78	–	118	15	50	–	150	50
Carbon Tetrachloride	56-23-5	60	–	137	21	50	–	150	50
Chlorobenzene	108-90-7	78	–	118	15	50	–	150	50
Chloroform	67-66-3	68	–	124	15	50	–	150	50
Methyl Ethyl Ketone	78-93-3	30	–	150	35	50	–	150	50
Tetrachloroethene	127-18-4	78	–	118	20	50	–	150	50
Trichloroethene	79-01-6	76	–	120	15	50	–	150	50
Vinyl Chloride	75-01-4	53	–	148	35	50	–	150	50
SVOCs									
1,4-Dichlorobenzene	106-46-7	51	–	109	35	50	–	150	50
2,4-Dinitrotoluene	121-14-2	35	–	100	42	50	–	150	50
2,4,5-Trichlorophenol	95-95-4	49	–	104	40	50	–	150	50
2,4,6-Trichlorophenol	88-06-02	47	–	104	37	50	–	150	50
2-Methylphenol (Cresol, o-)*	95-48-7	47	–	112	47	50	–	150	50
3-Methylphenol (Cresol, m-)*	108-39-4	49	–	113	35	50	–	150	50
4-Methylphenol (Cresol, p-)*	106-44-5	49	–	113	35	50	–	150	50
Hexachlorobenzene	118-74-1	33	–	100	22	50	–	150	50
Hexachlorobutadiene	87-68-3	51	–	109	38	50	–	150	50
Hexachloroethane	67-72-1	49	–	108	38	50	–	150	50
Nitrobenzene	98-95-3	47	–	118	26	50	–	150	50
Pentachlorophenol	87-86-5	10	–	102	40	50	–	150	50
Pyridine	110-86-1	44	–	126	40	50	–	150	50
OPCs									
Chlordane	57-74-9	40	–	130	20	50	–	150	50
Endrin	72-20-8	73	–	128	15	50	–	150	50
Heptachlor (and its Epoxide)	76-44-8	70	–	132	15	50	–	150	50
Lindane	58-89-9	61	–	125	16	50	–	150	50
Methoxychlor	72-43-5	63	–	133	15	50	–	150	50
Toxaphene	8001-35-2	40	–	130	20	50	–	150	50
Herbicides									
2,4-D	94-75-7	22	–	125	35	50	–	150	50
2,4,5-TP (Silvex)	93-72-1	35	–	137	34	50	–	150	50
PCBs									
Total PCBs	1336-36-3	46	–	122	23	50	–	150	50
Cyanide									
Total cyanide	57-12-5	38	–	162	20	50	–	150	50
Sulfide									
Sulfide	18496-25-8	85	–	115	20	50	–	150	50
Ignitablility									
Ignitablility	NA	NA	–	NA	NA	NA		NA	NA
pH									
pH	NA	99	–	101	2	NA		NA	NA

RPD-relative percent difference
OPC-Organochlorine Pesticides
SVOC-semivolatile organic compounds
VOC-volatile organic compounds
CAS - chenical abstract service
FD - field duplicate

Table 3. Sampling Information for Liquid Waste and Soil Samples
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Sample ID	Sample Type	Matrix	Metals	VOCs	SVOCs	OCPs	Herb.	PCBs	TCLP Metals	TCLP VOCs	TCLP SVOCs	TCLP OCPs	TCLP Herb.	Cyanide	Sulfide	Ignit-ability	pH
ELF-LW-DG1-COMPX-MMDDYY to ELF-LW-DGX-COMPX-MMDDYY	Composite	Liquid Waste	x	x	x	x	x	x						x	x	x	x
ELF-LW-DG1-COMPX-MMDDYY to ELF-LW-DGX-COMPX-MMDDYY	Composite		x	x	x	x	x	x						x	x	x	x
ELF-LW-DG1-COMPX-MMDDYY to ELF-LW-DGX-COMPX-MMDDYY	Composite		x	x	x	x	x	x						x	x	x	x
ELF-SW-DGX-COMPX-MMDDYY to ELF-SW-DGX-COMPX-MMDDYY	Composite	Solid Waste						x	x	x	x	x	x	x	x	x	x
ELF-SL-DGX-COMPX-MMDDYY to ELF-SL-DGX-COMPX-MMDDYY	Composite	Sludge Sample						x	x	x	x	x	x	x	x	x	x
ELF-SS-DGX-COMPX-MMDDYY to ELF-SS-DGX-COMPX-MMDDYY	Composite	Soil Sample							x	x	x	x	x	x	x	x	x
ELF-SS-CMPDX-COMPX-MMDDYY to ELF-SS-CMPDX-COMPX-MMDDYY	Composite								x	x	x	x	x	x	x	x	x
ELF-SS-CONFX-ESWX-MMDDYY to ELF-SS-CONFX-ESWX_MMDDYY	Grab								x	x	x	x	x	x	x	x	x
ELF-SS-CONFX-FSX-MMDDYY to ELF-SS-CONFX-FSX-MMDDYY	Grab								x	x	x	x	x	x	x	x	x

Notes:
1. ID: Identification
2. VOC: Volatile Organic Compound
3. SVOC: Semi-Volatile Organic Compound
4. TCLP: Toxicity Characteristic Leaching Procedure
5. SS: Soil Sample

Table 4. Summary of Sample Containers, Preservation and Holding Times
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Matrix	Parameter (Analysis)	Sample Container	Preservation	Holding Time
Soils / Sludge	TCLP VOCs (EPA 1311/8260C)	1-4 oz WM glass jar with Teflon lined lid and minimal headspace	Cool to ≤ 6º C but not frozen	14 Days from Collection to Extraction 14 Days from Extaction to Analysis
	TCLP SVOCs (EPA 1311/8270D)	3 - 8 oz WM glass jars with Teflon lined lids	Cool to ≤ 6º C but not frozen	14 Days from Collection to TCLP Extraction, 7 Days from TCLP Extraction
	TCLP OCPs (EPA 1311/8081B)		Cool to ≤ 6º C but not frozen	14 Days from Collection to TCLP Extraction, 7 Days from TCLP Extraction
	TCLP Herbicides (EPA 1311/8151A)		Cool to ≤ 6º C but not frozen	14 Days from Collection to TCLP Extraction, 7 Days from TCLP Extraction to Prep. Extraction, 40 Days from Prep. Extaction to Analysis
	Metals TCLP Extraction (EPA Methods 1311/6010C/7470A)		Cool to ≤ 6º C but not frozen	180 Days from Collection to Extraction 180 Days from Extraction to Analysis; 28/28 Days for Mercury
	PCBs (EPA Method 8082A)		Cool to ≤ 6º C but not frozen	1 Year
	Cyanide (EPA Method 9014)		Cool to ≤ 6º C but not frozen	14 Days
	Sulfide (EPA Method 9030B/9034)		Cool to ≤ 6º C but not frozen	7 Days
	Ignitablity (EPA Method SW 846 7.1.2)		Cool to ≤ 6º C but not frozen	NA
	pH (EPA Method 9045D)		Cool to ≤ 6º C but not frozen	24 Hours
Liquid Waste	VOCs (EPA Method 8260C)	1-4 oz WM glass jar with Teflon lined lid and minimal headspace	Cool to < 6º C but not frozen	180 Days; Mercury 28 Days
Liquid Waste	Metals (EPA Methods 6010C/7471B)	3 - 8 oz WM glass jars with Teflon lined lids	Cool to ≤ 6º C but not frozen	14 Days
	SVOCs (EPA Method 8270D)		Cool to ≤ 6º C but not frozen	14 days to extract, 40 days to analyze
	PCBs (EPA Method 8082A)		Cool to ≤ 6º C but not frozen	1 Year
	Cyanide (EPA Method 9014)		Cool to ≤ 6º C but not frozen	14 Days
	pH (EPA Method 9045D)		Cool to ≤ 6º C but not frozen	7 Days
	OCPs (EPA 8081B)		Cool to ≤ 6º C but not frozen	14 days to extract, 40 days to analyze
	Herbicides (EPA 8151A)		Cool to ≤ 6º C but not frozen	14 days to extract, 40 days to analyze
	Ignitability (EPA Method 1010A)		Cool to ≤ 6º C but not frozen	28 Days
	Sulfide (EPA Methods 9031/9034)	1-4 oz WM glass jar with Teflon lined lid, 1/2 filled	Cool to ≤ 6º C but not frozen	24 Hours

Notes:
1. EPA: United States Environmental Protection Agency
2. WM: Wide-Mouth
3. C: Centigrade
4. VOC: Volatile Organic Compound
5. SVOC: Semivolatile Organic Compound
6. TCLP: Toxicity Characteristic Leaching Procedure
7. oz: ounce
8. mL: milliliter
9. L: liter
10. HNO3: Nitric Acid
11. HCl.: Hydrochloric Acid
12. NaOH: Sodium Hydroxide
13. H2SO4: hydrochloric acid
14. OCPs: organochlorine pesticides

Table 5. Field Quality Control Samples
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Parameter	Matrix	Trip Blanks	MS/MSD[1]	Field Duplicates	Equipment Rinsate Blanks[2]
Metals	Liquid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
VOCs	Liquid	1 per cooler of VOC samples	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
SVOCs	Liquid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
OCPs	Liquid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
Herbicides	Liquid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
TCLP Metals	Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
TCLP VOCs	Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
TCLP SVOCs	Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
TCLP OCPs	Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
TCLP Herbicides	Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
PCBs	Liquid / Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
Cyanide	Liquid / Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
Sulfide	Liquid / Solid	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples or 1 per day
Ignitablilty	Liquid / Solid	NA	NA	1 per 20 samples	NA
pH	Liquid / Solid	NA	NA	1 per 20 samples	NA

Notes:
1. Field personnel must collect triple volume to account for MS/MSD sample.
2. No equipment blanks are required for disposable or dedicated field sampling equipment.
3. NA: Not Applicable
4. VOC: Volatile Organic Compound
5. SVOC: Semi-Volatile Organic Compound
6. OCP: Organochlorine Pesticides
7. TCLP: Toxicity Characteristic Leaching Procedure
8. MS/MSD: Matrix Spike/Matrix Spike Duplicate

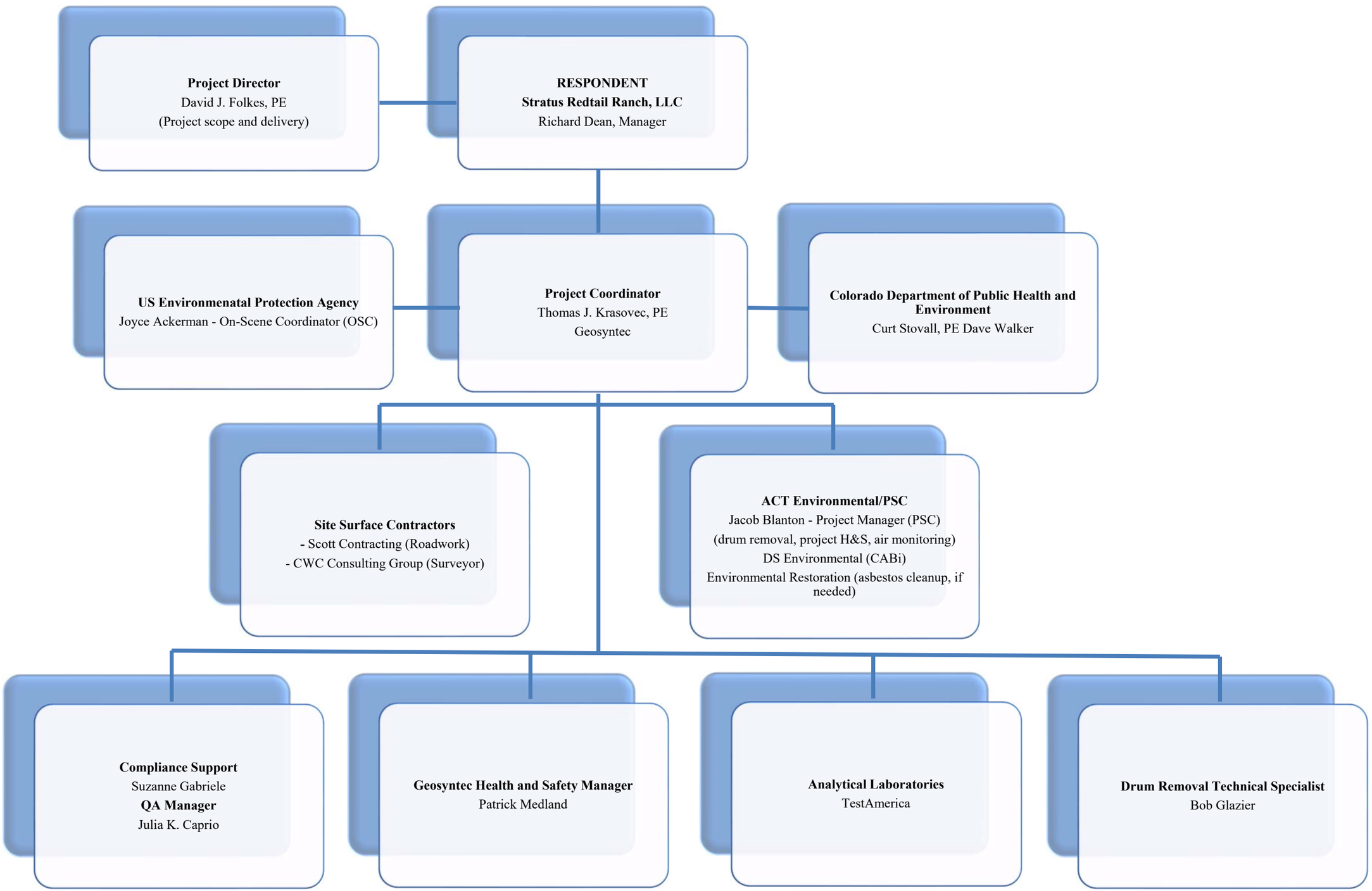
Table 6. Instrument Preventative Maintenance
Drum Removal Work Plan
Neuhauser Landfill
Erie, Colorado

Instruments	Maintenance Procedures/Schedule	Spare Parts
RAE Systems RAE 3000 PID* Photoionization Detector	1. Calibrate at the beginning and end of each day and as necessary during use with gases specified in manual. 2. Check battery and recharge/change when low. 3. Check and replace lamps as necessary. 4. Clean instrument as necessary and store in carrying case. 5. Replace expired calibration compounds.	See product user's manual

Notes: * Or similar equipment

FIGURES

Figure 1
Neuhauser Landfill Drum Removal - Project Team Organization Chart



DRAFT

GENERAL SITE PLAN
NEUHAUSER LANDFILL SITE
STRATUS REDTAIL RANCH LLC
ERIE, COLORADO

Geosyntec consultants

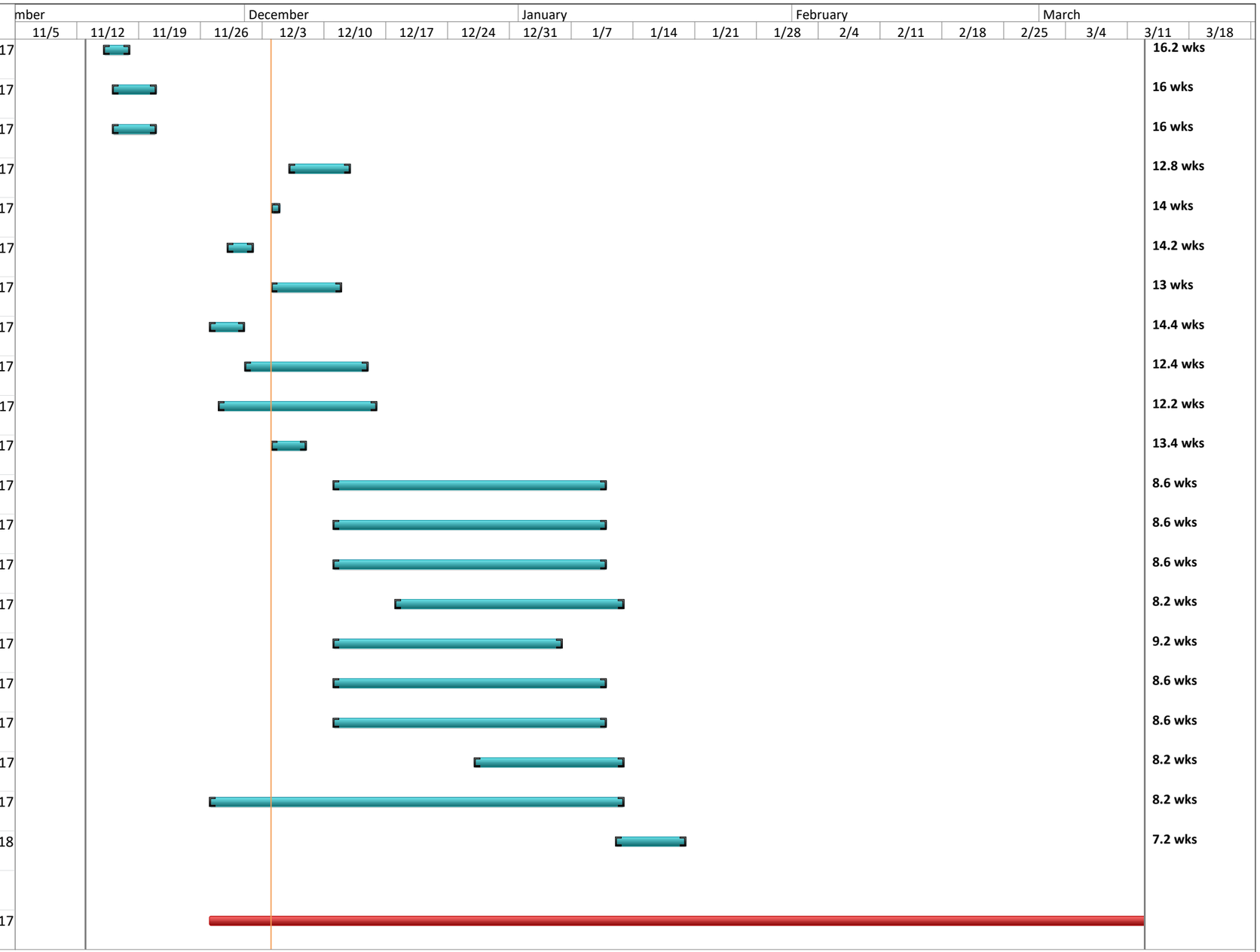
FIGURE 2

PROJECT NO: DE0302 | NOVEMBER 2017

P:\CADD\CIVIL 3D\COLORADO\REDTAIL\FIG1-2 - Last Saved by: skhalameyzer on 11/15/17

FIGURE 3

ID	Name	Duration	Start	
1	Draft AOC and DRWP Submittal Including Attachments.	0.6 wks	Wed 11/15/17	16.2 wks
2	EPA Review and Comment	0.6 wks	Thu 11/16/17	16 wks
3	CDPHE Review and Comment	0.6 wks	Thu 11/16/17	16 wks
4	Final Submittal of DRWP and all Attachments	1 wk	Wed 12/6/17	12.8 wks
5	Public Meeting	0.2 wks	Mon 12/4/17	14 wks
6	Additional EM Survey and Investigation	0.6 wks	Wed 11/29/17	14.2 wks
7	Data Assessment and Reporting	1.2 wks	Mon 12/4/17	13 wks
8	Mobilization of Equipment to Site	0.8 wks	Mon 11/27/17	14.4 wks
9	Setup Air Monitoring Equipment	2 wks	Fri 12/1/17	12.4 wks
10	Site Preparation, including Roads, Staging Areas etc.	2.8 wks	Tue 11/28/17	12.2 wks
11	Install Sediment Control Berms and Silt Fence etc.	0.8 wks	Mon 12/4/17	13.4 wks
12	Excavation and staging of clean soils to uncover buried Drums	4.6 wks	Mon 12/11/17	8.6 wks
13	Drum sampling, containment and staging for transport	4.6 wks	Mon 12/11/17	8.6 wks
14	Removal of Impacted soils around drums	4.6 wks	Mon 12/11/17	8.6 wks
15	Excavation of Sludge area and loading into transports/rolloffs	4 wks	Mon 12/18/17	8.2 wks
16	Sampling and characterization of Sludge materials for Transport and Disposal	4 wks	Mon 12/11/17	9.2 wks
17	Transportation and Disposal of Hazardous Wastes	4.6 wks	Mon 12/11/17	8.6 wks
18	Transportation and Disposal of non-hazardous waste	4.6 wks	Mon 12/11/17	8.6 wks
19	General grading, cleanup and decontamination of equipment	2.6 wks	Wed 12/27/17	8.2 wks
20	Personnel Decontamination	7 wks	Mon 11/27/17	8.2 wks
21	Demobilization	1.2 wks	Fri 1/12/18	7.2 wks
22				
23	Reporting	15.2 wks	Mon 11/27/17	



Critical		Milestone		Project Summary		External Milestone		Manual Task		Start-only	
Critical Split		Slack		Rolled Up Critical		Inactive Task		Duration-only		Finish-only	
Task		Slippage		Rolled Up Critical Split		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		Summary		External Tasks		Inactive Summary		Manual Summary		Progress	

ATTACHMENT A

Example Chain-of-Custodies

Pages 1773-2573 of the original document were deleted with Exemption 4 marked on them.

These pages were deleted with the approval of the requester as Adobe had issues with saving the redactions.