July 25, 2019

Mr. Jesse Aviles, U.S. Environmental Protection Agency
Mr. Fonda Apostolopoulos, Colorado Department of Public Health and Environment
Mr. Andrew Ross, Denver Department of Public Health and Environment
Ms. Kara Edewaard, Denver Department of Public Health and Environment

RE: Sanitary sewer relocate through Vasquez Boulevard and I-70 Superfund Site

This letter is in response to the information received from the Denver Department of Public Health and Environment (DDPHE) dated June 7, 2018 regarding the construction activities of a sanitary sewer for the Central 70 Project within Operable Unit 2 (OU2) of the Vasquez Boulevard and I-70 Superfund Site. Kiewit Meridiam Partners (KMP) is required to complete this work in coordination with the U.S. Environmental Protection Agency, the Colorado Department of Public Health and Environment, and DDPHE.

As requested, prior to commencing construction activities within OU2, KMP has prepared the following information as it pertains to the operation. All information listed here can be found in the attached packet.

- Attachment 1: Pre-construction sampling workplan
- Attachment 2: Sanitary sewer construction workplan
- Attachment 3: Materials Management Plan
- Attachment 4: Sampling and Analysis Plan
- Attachment 5: Health and Safety Plan
- Attachment 6: Central 70 Land Development Permit and Fugitive Dust Plan
- Attachment 7: Community Advisory Group Factsheet

KMP understands that they are responsible for meeting all other obligations in the memo as well as any additional requirements set forth by the above-mentioned agencies or the Colorado Department of Transportation (CDOT). KMP also commits to sharing all data related to the environmental aspects of the project within OU2 with these agencies.

If there are any questions or concerns, please contact me at megan.wood1@kiewit.com or (970) 819-8147.

Sincerely,

Megan Wood

Digitally signed by Megan Wood
DN: C=US, E=megan.wood1@kiewit.com, O=Kiewit Infrastructure Co., OU=Central 70, CN="Megan Wood "
Reason: I have reviewed this document
Date: 2019.07.25 07:55:08-06'00'

Megan Wood, Environmental Manager
Kiewit Meridiam Partners

Attachment 1: Pre-construction sampling workplan

OU2 Sample Collection Work Plan

1. Operation

At each of the four locations (represented in Figures 1 and 2), the Direct Push-rig will advance a sample rod continuously in 4-foot increments in order to collect a representative, and relatively undisturbed, core sample of the subsurface material that is anticipated to be encountered during installation of the sewer line. A Direct Push-rig "pushes" the sample rod into the ground without the use of drilling to remove soil to make a path for the tool. Direct push tools do not remove cuttings from the probe hole but depend on compression of soil or rearrangement of soil particles to permit advancement of the sample rod. A dual tube sampling scheme will be utilized for this investigation collect continuous soil cores. One set of rods is driven into the ground as an outer casing. These rods receive the driving force from the hammer and provide a sealed hole from which soil samples may be recovered without the threat of cross contamination. The second, smaller set of rods are placed inside the outer casing. The smaller rods hold a sample liner in place as the outer casing is driven one sampling interval. The small rods are then retracted to retrieve the filled liner.

Up to three (3) samples will be collected from the recovered core. Soil samples will be collected at three (3) intervals within each vertical bore: 1) within the unsaturated/vadose zone in the 1-5 foot interval, 2) at the groundwater interface, and 3) at the bottom of the excavation (approximate elevation 5150')/ termination point of the bore, or the interval of soil/fill material where the highest head-space reading is observed. The samples will be placed in laboratory supplied jars and placed in a cooler with ice.

Remaining soils (not submitted for laboratory analysis) will be placed in a 55-gallon drum and staged onsite until waste characterization is complete and a waste profile is generated for its final disposal. With a max drilling depth of less than 20 feet below ground surface (bgs) we are expecting to not generate more than one (1) 55-gallon drum of Investigation Derived Waste (IDW). There will be no need for a laydown area or stockpiling of materials as the extent of surface disturbance will be four (4) 2.25-inch diameter holes.

The attached website shows a video as to the low impact nature of the Direct Push rig.
https://geoprobe.com/dt22-soil-sampling-system

Sampling and documentation will be in accordance with the approved Sampling and Analysis Plan and the Materials Management Plan. Temporary well applications will also be submitted prior to conducting boring operations.

A hazard analysis will be completed onsite with the crew prior to beginning the sampling operation. All crew members, superintendents, and anyone observing the operation will be required to review and sign the hazard analysis. The work area will not be physically blocked off for the sampling operation, however the superintendent or project manager for the operation will ensure pedestrians or workers not involved in the operation do not enter the work area without permission.

2. Schedule

Upon approval of all plans and applicable documents, Iron Woman will schedule sampling with Vista Geoscience. Once scheduled, the physical sampling in the field will take one day. The drill rig will mobilize to site in the morning, conduct the sampling, and demobilize that day, pending any unforeseen circumstances. Depending on groundwater observations during the sample collection,

Iron Woman may conduct additional aquifer testing for a second day. Samples will be taken to the laboratory and analyzed on an expedited turnaround time.

3. Personnel

- Sampling collection, documentation, field observations
  Iron Woman Construction and Environmental Services
  Andrew Umyn, Environmental Specialist
  303.947.6453
  aumyn@ironwomancon.com

- Direct-push rig services
  Vista Geoscience
  Golden, CO
  303.277.1694

- Laboratory services
  Origins Laboratory
  Jen Pellegrini
  303.433.1322
  jpellegrini@originslab.com

- Operations oversight
  Kiewit Meridiam Partners
  Megan Wood, Environmental Manager
  970.819.8147
  megan.wood1@kiewit.com

FIGURE 1
Proposed DPT Bore Locations
Environmental Investigation Related to EPA Superfund Site asociated with C70 DWWMD Package 5

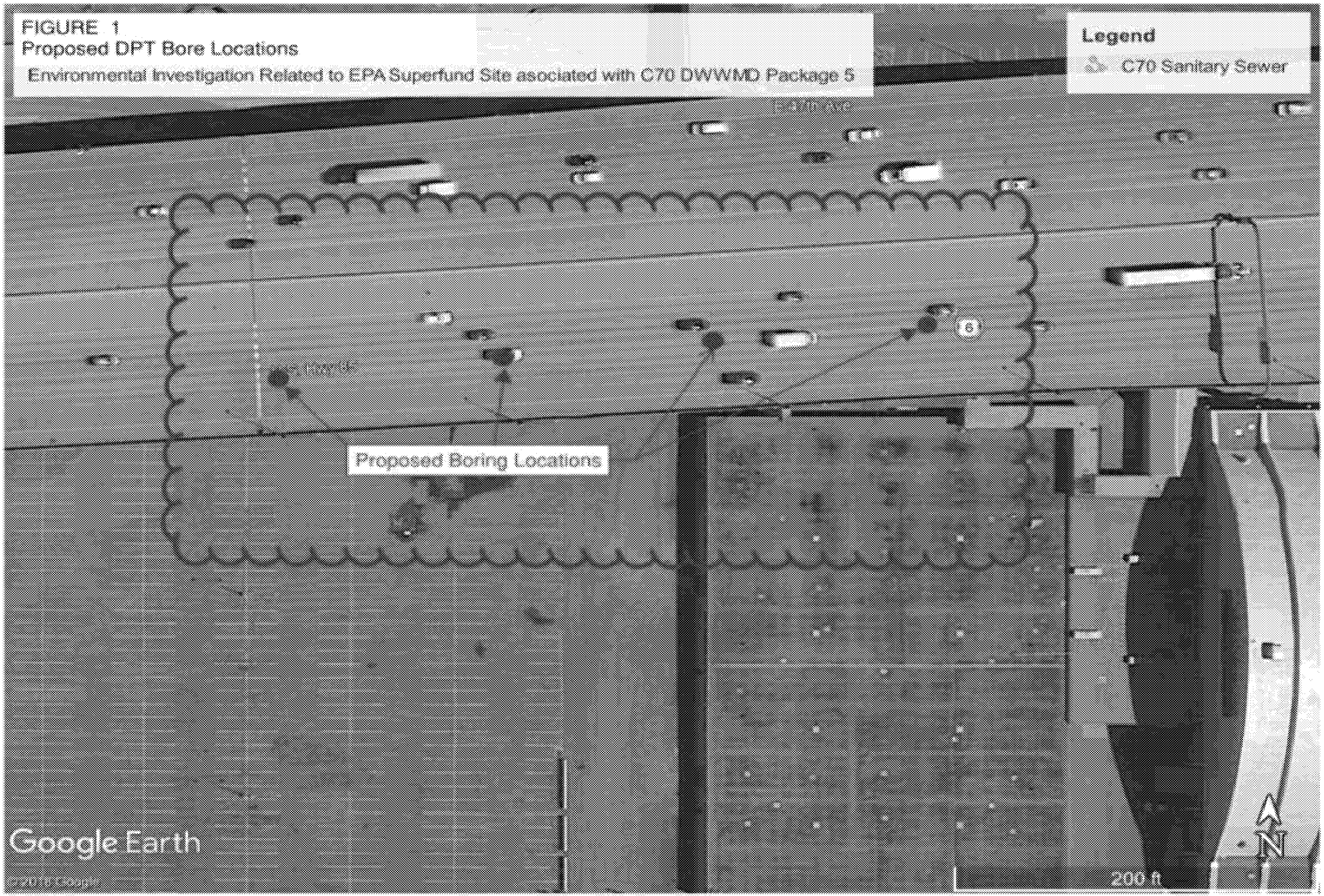
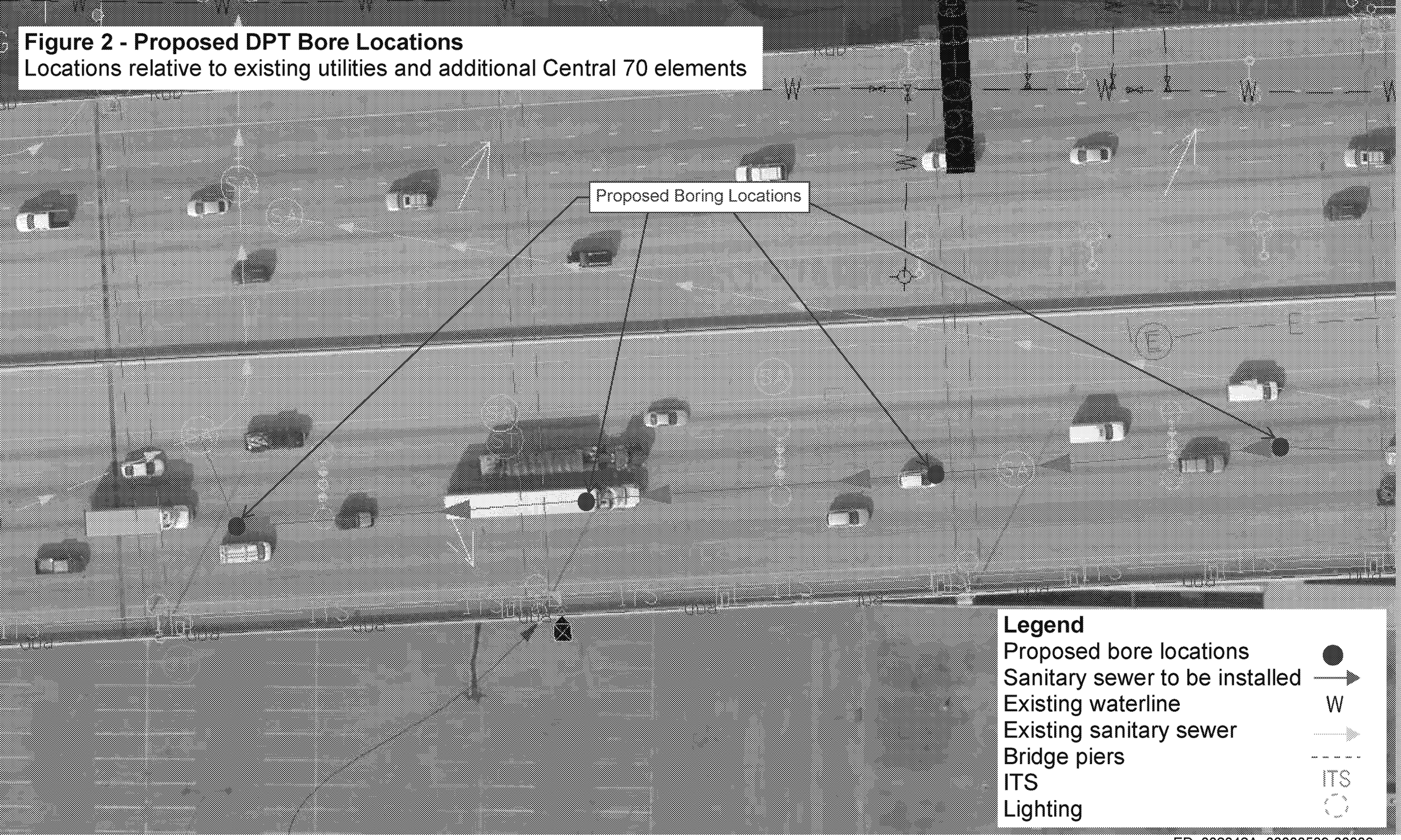
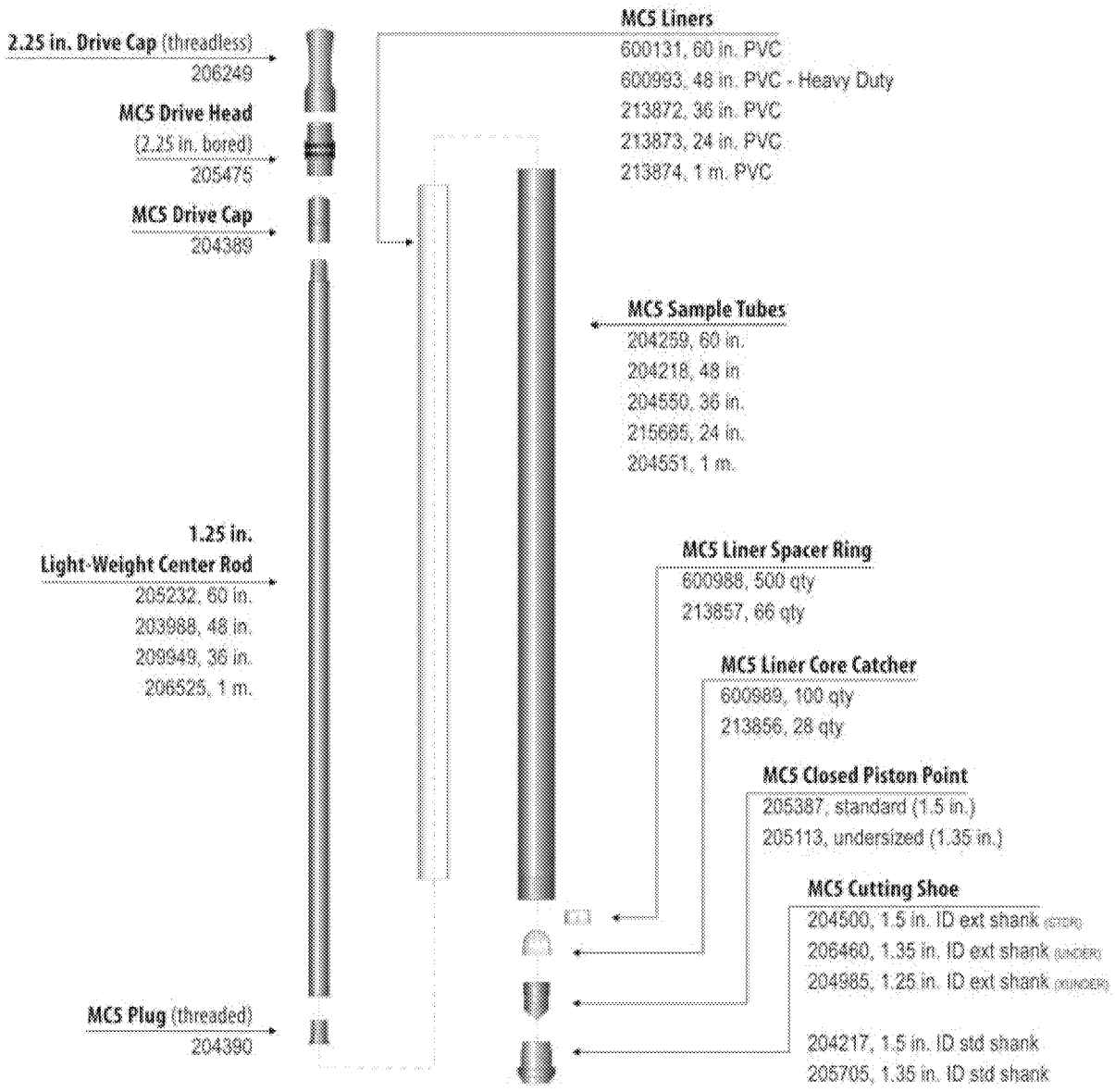


Figure 2 - Proposed DPT Bore Locations
Locations relative to existing utilities and additional Central 70 elements

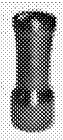


Macro-Core® MC5 Soil Sampling System (LWCR) *

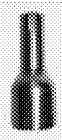
geoprobe.com/mc5



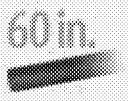
* Light Weight Center Rods



2.25 DRIVE CAP THDLS HD GH60 SERIES
MN: ***206249*** PN: 31530



2.25 DRIVE CAP THDLS GH40 SERIES
MN: ***206187*** PN: 31405



MC5 Sample Tube (60 in.)
MN: ***204259*** PN: 22992

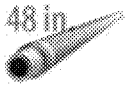
MC5 Sample Tube (48 in.)
MN: ***204218*** PN: 22923

MC5 Sample Tube (36 in.)
MN: ***204550*** PN: 24238

MC5 Sample Tube (24 in.)
MN: ***215665*** PN: 24237

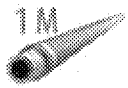
MC5 Sample Tube (1m.)
MN: ***204551*** PN: 24239

1.25 in. Light-Weight Center Rod (60 in.)
MN: ***205232*** PN: 27600



1.25 in. Light-Weight Center Rod (48 in.)
MN: ***203988*** PN: 21900

1.25 in. Light-Weight Center Rod (36 in.)
MN: ***209949*** PN: 43012

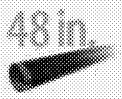


1.25 in. Light-Weight Center Rod (1m.)
MN: ***206525*** PN: 32318

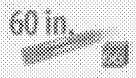
MC5 Liner Teflon 60 in. (Built to Order)
MN: ***219147*** PN: 38752

MC5 LINER TEFLON 48 in. (Built to Order)
MN: ***200596*** PN: 5131

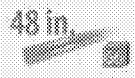
MC5 Liner ASM SS 60 in. (Built to Order)
MN: ***202873*** PN: 16315



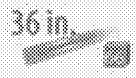
MC5 LINER ASM SS 48 in. (Built to Order)
MN: ***213840*** PN: AT7235



MC5 LINER PVC 60 in. (66)
MN: ***600131*** PN: 10074



MC5 LINER PVC 48 in. (66)
MN: ***600993*** PN: AT927K



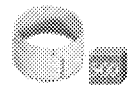
MC5 LINER PVC 36 in. (66)
MN: ***213872*** PN: AT921K

MC5 LINER PVC 24 in. (66)
MN: ***213873*** PN: AT926K

MC5 LINER PVC 1m. (66)
MN: ***213874*** PN: AT928K

MC5 LINER CUTTER
MN: ***213845*** PN: AT8010

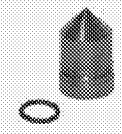
MC5 LINER SPACER RING (66)
MN: ***213857*** PN: AT8532K



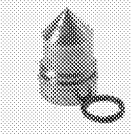
MC5 LINER SPACER RING (500)
MN: ***600988*** PN: AT8533K

MC5 LINER CORE CATCHER (28)
MN: ***213856*** PN: AT8531K

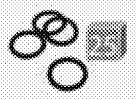
MC5 LINER CORE CATCHER (100)
MN: ***600989*** PN: AT8534K



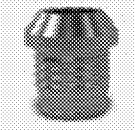
MC5 PISTON PT
MN: ***205387*** PN: 28113



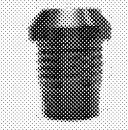
MC5 PISTON PT UNDERSIZED
MN: ***205113*** PN: 26865



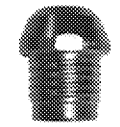
O-Ring MC5 Pt / DT22 Pt / SP16 SS Screen
MN: ***213918*** PN: DT4070R



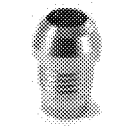
MC5 CUTTING SHOE 1.5 in. ID STD SHANK
MN: ***204217*** PN: 22922



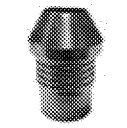
MC5 CUTTING SHOE 1.5 in. ID EXT SHANK (2.375 in. OD)
MN: ***204500*** PN: 23978



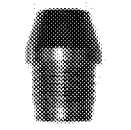
MC5 Cutting Shoe 1.35 in. ID STD Shank (2.375 in. OD)
MN: ***205705*** PN: 29552



MC5 Cutting Shoe 1.35 in. ID Ext Shank (2.3 in. OD)
MN: ***206460*** PN: 32035

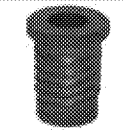


MC5 CUTTING SHOE 1.25 in. ID EXT SHANK (2.375 in. OD)
MN: ***204985*** PN: 26078

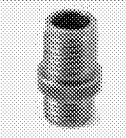


MC5 Cutting Shoe Tapered (2.25 in. OD)
MN: ***206560*** PN: 32490

CENTER ROD DRIVE CAP 1.25
MN: ***204389*** PN: 23639

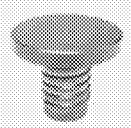


MC5 CENTER ROD PLUG 1.25 THD
MN: ***204390*** PN: 23641



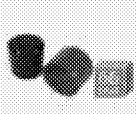
MC5 DRIVE HEAD 2.25 CENTER ROD 2.375 OD
MN: ***205475*** PN: 28646

HYD EXTRUDER MC5 ADAPTER
MN: ***205697*** PN: 29532



HYD EXTRUDER PLUNGER MC5
MN: ***203559*** PN: 19520

BRUSH NYLON MC/MC5 TOOLS
MN: ***601003*** PN: BU700



MC5 VINYL END CAPS (66 PR)
MN: ***213843*** PN: AT726K

Attachment 2: Sanitary sewer construction workplan

Safety

	Actual / Potential Severity Levels	Actual / Potential Severity Level *(How bad could it have been?)*
(Red) Diamond Events	**Level 5** **"Multiple Fatalities"** "Potentially Multiple Fatalities"	Multiple Fatalities
	Level 4 **"Fatality"** "Potential Fatality"	Fatality
Diamond Events	**Level 3** **"Severe"** "Severe Potential"	Injuries or illnesses causing severe physical body damage with probable long-term and/or significant life-altering complications such as: • Life-altering fractures, lacerations, or penetrations • Amputations (All) • Significant third degree burns • Disfigurement • Loss / impairment of body organ function • Severe to complete loss of hearing • Severe visual impairment to total blindness • Confirmed debilitating ergonomic or Serious Illness Events (SIE) cases
	Level 2 **"Moderate"** "Moderate Potential"	Injuries or illnesses causing significant physical body damage; reasonably expected to heal without significant life-altering complications in a moderate time period (week(s) to months) such as: • Fractures, Loss of tooth/teeth • Lacerations / penetrations • Significant second degree burns (blistering) • Minor third degree burns • Significant Sprains & Strains • Major infections post-injury or from illness • Dislocations • Punctured ear drum or moderate to moderately severe hearing loss • Moderate visual impairment • Confirmed ergonomic and SIE cases requiring significant treatment, surgery or physical therapy
	Level 1 **"Minor"** "Minor Potential"	Injuries or illnesses causing minor physical body damage; reasonably expected to heal without any life-altering complications in a short time period (hours to days) such as: • Minor lacerations / penetrations (that bleed freely) • Minor chipping or cracking of a tooth/teeth • Minor second degree burns (blistering) • Skin rashes / burns from exposure to chemicals / non-aqueous fluids • Sprains & Strains • Minor Infections post-injury or from illness • Bruises • Partial and self-resolving dislocations • Confirmed slight to mild hearing loss • Mild eye (corneal) abrasions • Confirmed ergonomic or SIE cases requiring minor treatment
	Level 0 **"No Hurt"** "No Potential"	No Hurt occurred (no physical body damage) but there are actionable learnings to take to possibly prevent future Hurt.

Central 70

RED DIAMOND

TRAFFIC

1. No one will ever cross interstate traffic.
2. Positive protection is required for all operations working near traffic.
3. Position yourself with your eye on the risk.
4. Plan your vehicular access into and out of work zones to protect yourself and the travelling public.

FALLS

1. You will be trained to inspect and properly wear fall protection when required.
2. Dropped object prevention will include tool tethers and/or drop zone protection.
3. Positive protection (handrails, fencing etc.) will be in place for the safety of you and the public.

UTILITIES

1. We will not dig unless we know where all the utilities are and we have followed our Dig Permit process.
2. We will use engineering to properly support utilities.
3. Demand perfection when working around trenches and deep excavations.

LIFTING EQUIPMENT

1. A lift plan must be completed prior to any pick that utilizes rigging.
2. Qualified Riggers and Signalmen will be used.
3. A site specific JHA will be in place when working near overhead power.
4. We will follow our Corporate Crane guidelines when moving and setting up a crane.

STRUCK BY

1. We must have positive acknowledgment with the operator.
2. We must follow our trailer "Loading & Unloading" procedures.
3. We must follow our "Red Bolt" process.
4. We will stay clear of the "Crush Zone" when trucks are dumping material.

5 KEYS

1. HIRE THE RIGHT PEOPLE

- We want to hire craft with a Kiewit Safe attitude and low risk tolerance.
- We want engaged craftsmen who believe "Nobody Gets Hurt".

2. KNOW THE DETAILS

- Every supervisor shall have a detailed work plan and JHA that addresses the task specific hazards.

3. CRAFT OWNERSHIP

- Craft Voice in Safety (CVIS) creates a culture where everyone has a voice. Craft are taking care of craft, in a partnership with management, through ownership, communication and prevention.

4. LEAD BY EXAMPLE

- Every employee should be a safety leader and coach and not allow themselves or anyone else to take shortcuts.

5. RECOGNIZE CHANGE

- When changes occur STOP and make corrections to our Work Plan / JHA and communicate those changes.

Kiewit meridiam PARTNERS

*Potential **Red Diamonds** **Near Us***

Package: Havana South Pond Crossing
Area: SE Corner of Havana & I-70 (Block 6311)

Traffic

No Traffic risk for this scope

Utilities

- Existing electric lines on north side of exit ramp, in median, and south side of entrance ramp -- **POTHOLE** existing utilities

Falls

- Using a ladder to climb in/out of trench box -- maintain **3 POINTS OF CONTACT**

Struck By

- Have 2 excavators and 1 loader in operation -- make **EYE CONTACT** and **GIVE HAND SIGNALS** with operators

Lifting Equipment

- Using excavator to raise and lower pipe or structures in to the cut

- Moving around large trench box (20' spreaders) -- keep clear of **CRUSH POINTS**

Field Notes:

Life Threating Utilties

Verification Still Needed on Existing Utilities

STANDARD OPERATING PROCEDURE
Life-Threatening Utilities

Purpose

The purpose of this procedure is to ensure that proper controls and management is in place when working around life-threatening utilities.

Scope

This procedure applies to both underground and overhead operations where the contact or strike with a life-threatening utility is possible.

Definitions

Life-threatening Utility is defined as the following utilities.

GAS- Any gas line including underground service lines. It will also include any gas line in any building or warehouse we utilize on the project.

ELECTRIC- Any power over 240 volts.

NOTE: If sewer or water pose a life threatening risk.

Procedure

- A copy of this SOP will be included in the work plan.
- The foreman and superintendent will both be present at all times for all work where we may encounter life-threatening utilities.
- A separate specific work plan will be required for operations where we may encounter life-threatening utilities. This will be completed prior to the start of the major operation. This plan should consider the utilization of our hydro vac trucks to assist in meeting compliance with our 3 foot rule.

Work Plan - SKETCH of how we work around Life Threatening- Utility

	Hold Point?	Procedure/Step-by-Step
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

JOB HAZARD ANALYSIS

DATE PREPARED: **PREPARED BY:**

OPERATION:

STEP BY STEP PLAN:
1.
2.
3.
4.
5.
6.

Access Identification		Fire & Explosion	
Scaffold	☐	Hot Work	☐
Man Basket	☐	Painting	☐
Man lift	☐	Sandblasting	☐
Ladders	☐	Hydro testing	☐
Stairs	☐	Pneumatic testing	☐
Barricades	☐		☐
Other:	☐		☐

Ergonomic risks	
Lifting	☐
Repetitive Motion	☐
Vibration	☐
Awkward Position (Kneeling down, overhead work, etc.)	☐
Same position for a long time	☐
Other: _____	☐
Other:	☐

Strategic Risks	Evident Risk	Needs Special Planning*
Eyes	☐	☐
Working at Heights	☐	☐
Confined Space	☐	☐
Overhead Cranes	☐	☐
Rigging	☐	☐
Overhead Work (Dropped Objects)	☐	☐
Lock-Out / Tag-out	☐	☐
Crush Points	☐	☐
Electrical	☐	☐
Lifting Material/Cranes/Pickers	☐	☐
Night Work (Lighting)	☐	☐
Access/Egress	☐	☐
Weather	☐	☐
Communication	☐	☐
Stored Energy		
• Pneumatic, Hydro	☐	☐
• Electrical, Tension	☐	☐
Equipment (Hand tools)	☐	☐
Line of Fire (Grinding, blasting)	☐	☐
Barricades/Open Holes	☐	☐
Slips, Trips and Falls	☐	☐
Awareness of other operations	☐	☐
Gangway and Bulkhead	☐	☐
Other:	☐	☐

STANDARD PPE	Required
Safety Glasses	☐
Ear Plugs	☐
Gloves	☐
Fall Protection	☐

UNIQUE PPE	Required
Goggles	☐
Ear Muffs	☐
Mask	☐
Respirator	☐
Tyvek Suit	☐
Knee pads	☐
Welding Hood/Lens for plasma cutting	☐
Leather/Kevlar Chaps	☐
Leather Hood	☐
Clear Face Shield	☐
Dark Face Shield	☐
Life Vest/PFD	☐
Other:	☐

Lead Man Name: (Print & Signature)

Reviewed by:		
Name	Badge	Date

*Name the Diamond Events (if any):

Rev. 5/16/12

	Step 1:	Step 2:	Step 3:
WHAT IS THE WORST THAT COULD HAPPEN?			
PREVENTION PLAN (Focus on behaviors)			
HOW ARE YOU MOST LIKELY TO GET HURT?			
PREVENTION PLAN (Focus on behaviors)			
OTHER RISKS TO BE AWARE OF?			
PREVENTION PLAN (Focus on behaviors)			

	Step 4:	Step 5:	Step 6:
WHAT IS THE WORST THAT COULD HAPPEN?			
PREVENTION PLAN (Focus on behaviors)			
HOW ARE YOU MOST LIKELY TO GET HURT?			
PREVENTION PLAN (Focus on behaviors)			
OTHER RISKS TO BE AWARE OF?			
PREVENTION PLAN (Focus on behaviors)			

JOB HAZARD ANALYSIS

Signing Sheet

Operation: Date Revised:

Reviewed with:

	Name	Badge #	Date	Translator Badge #	Job Number
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

TEMPLATE Work Plan

PROJECT NAME:	Central 70
PROJECT NUMBER:	103565

OPERATION:	Sanitary Tie in and 30" SDR-35		
LOCATION:	Denver Coliseum Parking Lot - Under Viaduct		
PLAN COMPLETED BY	John Ford	PLANNED FOREMAN:	Jorge Corolla
SCOPE OF WORK:	Tie into existing Metro T-Base Sanitary MH - Excavate and install 390LF of 30" Sewer line		

	TOP 5 SAFETY HAZARDS:	RED DIAMOND Category:
1	Underground Utility Strike	UTILITIES
2	Overhead/Nearby Structures	Struck By
3	Working around equipment	Struck By
4	Lifting Large Diameter Pipe	Lifting
5	Access in and out of Trench	Falls

	TOP 5 QUALITY RISKS:	TOLERANCES:
1	Vertical and horizontal alignment	+/- 1/2 inches
2	Bedding depth (67)	6" Under - 12" Over
3	SDR Joint Seating	Drive to Home Line
4	Backfill Compaction	95% 12-18" lifts with wheel
5	Tie in Structure viability	Check MH Prior to Start

CHECKLISTS / DRAWINGS REQUIRED:
Pipe Install Checklist
Dig Permit
Denver Wastewater Standards
DRAWINGS - SN50.001/002; SN50.100/200

CREW MAKEUP:

NAME(S):	POSITION:	QUANTITY:
Jorge Carrola	Foreman	1
Oscar Gonzalez Rodriguez	Operator	1
Eduardo Cruz-Sandavol	Water Truck	1
Ivan Carrola	Pipe Layor	1
German Vazquez	Labor	1
	Manhours Burned Each Day (@ 10 hour shifts):	**50**

BUDGET AND GOAL:

WBS CODE:	DESCRIPTION:	QUANTITY:	UoM:	BUDGET: MH's / UoM:	BUDGET: MANHOURS:	BUDGET: QTY / DAY:	GOAL: MH's / UoM:	GOAL: MANHOURS:	GOAL: QTY / DAY:
					0.0	-		0.0	-
					0.0	-		0.0	-
					0.0	-		0.0	-
					0.0	-		0.0	-
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					0.0	-		0.0	-
					0.0	-		0.0	-
					0.0	-		0.0	-
	Totals Summary:				**0.0**	**0.0 Days**		**0.0**	**0.0 Days**

PERMANENT MATERIALS:

DESCRIPTION:	QUANTITY:	UoM:
30" SDR-35	400	LF
67 Bedding Materials	440	TN
Mirifi	260	SY
New Soil Backfill	850	CY
Sanitary MH	1	EA

ST&S / SPECIALIZED PPE:

DESCRIPTION:	QUANTITY:

EQUIPMENT / SPECIALIZED RIGGING:

DESCRIPTION:	QUANTITY:	TRAINING?
950 Loader	1	Y
336 Excavator	2	Y
Water Truck	1	Y

SUBCONTRACTORS:

NAME:	SCOPE:	QUANTITY:
NA		

MHT's / VARIANCES:

DESCRIPTION:	NUMBER:
NA	

SURVEY:

REQUEST #	STEP REQUIRED FOR:
BY KIEWIT	

WORK PLAN PROCEDURE / STEP-BY-STEP:

	HOLD POINT:	GENERAL STEPS / PROCEDURE:	QTY:	UoM:
1		Verify Survey Layout		
2		Remove Exiting Asphalt - Load into trucks for haul off		
3	HOLD POINT	Excavate and Expose Metro MH - 48 NOTICE TO METRO REQUIRED		
4	HOLD POINT	Core Drill, Tie in and Collar - MATERIALS TO ME MAINFESTED AND HAULED TO DADS		
5		Excavate Sanitary Trench - install proper shoring and access		
6	HOLD POINT	Install 30" SDR-35 - Bed with 67 - Cover with Mirifi - INSPECOTR SIGN OFF	390	LF
7		Install MH	1	EA
8		Backfill trench	850	CY
9				
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	FIELD NOTES:
1	Verify that Kiewit provied potholing was complete
2	Verify that materiasl are onsite - Bedding materiasl need to be tested and verfified preior to use
3	
4	
5	
6	
7	
8	

CHANGES TO THE PLAN:

AFTER DAY 1	AFTER WEEK 1	AFTER MONTH 1

REQUIREMENTS:

ACCESS - COMPETENT PERSON? TEMPORARY STRUCTURE?	HOUSEKEEPING - RECEPTICLES AND DUMPSTERS?	MATERIAL HANDLING - INCLUDE DETAILED DRAWING

REQUIRED SUBMITTALS AND RFI's:

NUMBER	DESCRIPTION
	NA

ADDITIONAL ITEMS (WHEN APPLICABLE):

ITEM	YES	NO	N/A
HAZARD ANALYSIS - ALWAYS REQUIRED	x		
QUALITY ANALYSIS - ALWAYS REQUIRED	x		
SPECIALIZED RIGGING TRAINING			
CONFINED SPACE TRAINING			
CONFINED SPACE PLAN			
DESIGNATED OPERATORS			
HAND SIGNAL TRAINING			
PULMONARY FIT TESTING			
BLOOD LEAD TESTING			
APPLICABLE CONTRACT DRAWINGS			
CONTINGENCY PLAN			
SCHEDULE			
DAILY MANPOWER AND EQUIPMENT SCHEDULES			
METHOD ANALYSIS/PLANNED SHUTDOWN			
ACCESS / EGRESS FOR EACH LOCATION			
SITE LAYOUT AND/OR ACCESS PLAN			
MATERIAL HANDLING PLAN			
MATERIAL STORAGE AND LAYOUT PLAN			
CRANE PICK DRAWINGS / CRITICAL LIFT PLAN			
LIFT DRAWINGS			
FORMWORK DRAWINGS			
POUR SEQUENCE			
CONCRETE WASHOUT LOCATION			
FALL PROTECTION PLAN			
TRAFFIC CONTROL PLAN			
TRUCK MANAGEMENT PLAN			
EXCAVATION PLAN			
SURVEY PLAN			
ENVIRONMENTAL CHECKLIST/CONTROLS			
OTHER:			
OTHER:			

REVIEW WITH CREW:

NAME	SIGNATURE	DATE

WORK PLAN REVIEW AND SIGN OFF (BASED ON RISK ASSESSMENT)

LOW	MEDIUM	HIGH
SUPERINTENDENT	PROJECT MANAGER	SPONSOR / AREA MANAGER
FOREMAN		
FIELD ENGINEER		
CM / GENERAL SUPERINTENDENT		

SKETCHES, NOTES, AND CHANGES:

Power Line Permit

Operation:	Date:
Superintendent Responsible:	Dedicated Spotter (Required):
Voltage of line:	Height of line:
Prohibited Zone:	Clearance Distance:
Permit must be updated to reflect changes in operation. Permit must account for any new hazards associated with the change and preventative measures implemented.	

Circle yes or no	
Yes or No	Power Line Permit in the cab of the equipment
Yes or No	Is a competent signal person assigned to monitor the operation with the **sole responsibility** to verify the required clearance is maintained?
Yes or No	Is a competent supervisor present at the equipment during the operation with the **sole responsibility** of verifying all steps of the plan are being carried out and that the specified clearance between the power line and the Equipment or load is being maintained.
Yes or No	Does the Dedicated Spotter have a visual aid to assist in identifying the Prohibited Zone?
Yes or No	Does the Dedicated Spotter understand that he/she must NOT allow the equipment to breach the prohibited zone?
Yes or No	Does the Dedicated Spotter have direct contact with the Operator? (radio or air horn)
Yes or No	Has the Operator and all crew members that are a part of the operation been trained according to policy?
Yes or No	Are power line signs in place far enough in front of the hazard to allow the operator of the equipment adequate time to take evasive action?
If you answered No to any of the above questions STOP the operation!	

Table A – Minimum Clearance Distances

Voltage (Nominal, kV, Alternating	Minimum Clearance Distance
Up to 50	10’ (3 m)
Over 50 to 200	15’ (4.5 m)
Over 200 to 350	20’ (6 m)
Over 350 to 500	25’ (7.5 m)
Over 500 to 750	35’ (10 m)
Over 750 to 1000	45’ (14 m)
Over 1000	(as established by the power line owner/operator or registered professional engineer who is a Qualified person with respect to electrical power transmission and distribution)

Signature of Crew Members

PRINT:	SIGN:
All crew members that are a part of the operation must sign and understand contents of the permit.	

.

Superintendent Signature:	Date:
Job Superintendent is ultimately responsible for adherence to the Overhead Power Line Policy	

EXPIRES_____.

Start Date:		End Date:		Centennial DIG PERMIT	

1. GENERAL INFORMATION

Location of excavation (Attach Plans):		Depth:		Width:		Length:		
Drawing Numbers of Plans Attached (highlight utilities)								

2. LOCATE SERVICE NOTIFICATION

811 Ticket #:	Date Requested:	Note:	COA Ticket #:	Date Requested:	Note:
Ticket Description:					

3. PRE - WORK CHECKLIST

It is the Superintendent and Foremens responsibility to ensure this section is complete		Initials	If No STOP Variance is required
Are all utilities shown on drawings marked in field with paint?	Y / N		
Are all relocations and installed utilities accounted for?	Y / N		
Has a blind sweep been performed using locating device?	Y / N		
Have you performed a field verification to look for unknown utilities?	Y / N		
Have all utilities been potholed according to policy?	Y / N		
Are utilities safe or protected from being crushed by the equipment?	Y / N		
Does the crew understand the 3ft. hand dig policy?	Y / N		
Are updated utility drawings and any necessary as builts attached?	Y / N		
Has the Hazard Analysis been reviewed?	Y / N		

4. UTILITY CHECKLIST

COLOR	STANDARD UTILITY DESCRIPTION	Utilities Present in		Utilities	
		Engineer	Initials	Foreman	Initials
BLUE	Water Systems	Y / N		Y / N	
ORANGE	Telephone & Fiber Optics	Y / N		Y / N	
GREEN	Sanitary Sewer Systems	Y / N		Y / N	
RED	Elec. Power Distribution and Transmission	Y / N		Y / N	
YELLOW	Gas and Oil Products Dis.	Y / N		Y / N	
PURPLE	Reclaimed Water, Irrigation	Y / N		Y / N	
White/Red	Transportation	Y / N		Y / N	
Blank	Project Installed	Y / N		Y / N	
PINK	Survey	NA		NA	

5. SIGNATURES. Pre-Work Checklist is complete and policies/procedures communicated clearly?

Superintendent	Print Name:	Y / N	Signature:	Date:
Foreman	Print Name:	Y / N	Signature:	Date:
Operator	Print Name:	Y / N	Signature:	Date:
Utility Engineer	Print Name:	Y / N	Signature:	Date:
SubContractor	Print Name:	Y / N	Signature:	Date:
Crew Signature				

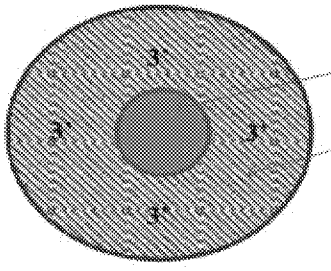
I am responsible for ensuring that the dig permit is complete, all existing utilities are located, marked, and visually verified , prior to penetrating the ground surface

Question Phone Number (Ryan): (303) 710-3661

Foreman Signature

3 Foot Rule

The minimum clearance of 3 feet shall be maintained between an underground utility and the cutting edge or point of any power operated excavating or earth moving equipment. If excavation is required within 3 feet of any utility, the excavation will be performed with extreme care utilizing hand tools or vacuum excavation techniques only.



Utility

Hand Dig Area

No Equipment is allowed to dig within a 3' radius of the utility unless a variance is obtained and approved by the Area Manager

Pothole Spacing and Frequency

Life Threatening Utilities

- Life threatening utilities such as gas and electrical services will be exposed through the entire length of the excavation.
- Gas and electric lines within 25 feet of your work area will be potholed and marked every 100 feet for design purposes and every 25 feet for construction operations in order to verify that the line has not changed directions.
- Gas and electric lines between 25 and 50 feet of the work zone will be potholed at least once on each end of the limits of the excavation to verify the One-Call Center locates and the utility plans.
- In addition to potholing at the spacing and frequencies shown above, each utility will be tracked using GPR and/or EM locators along the utility between each pothole location.

Communications Lines

- Fiber optic lines will be potholed every 100 feet for design and 25 feet for construction operations
- Telephone and cable will be potholed every 100 feet for design and 50 feet within the work area for construction operations.

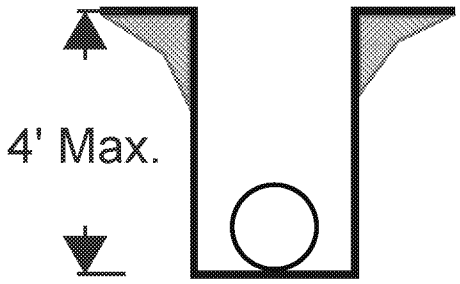
Other Utilities

- Utilities not identified above shall be potholed every 100 feet for design and 50 feet for construction operations on lines less than 24" in diameter.

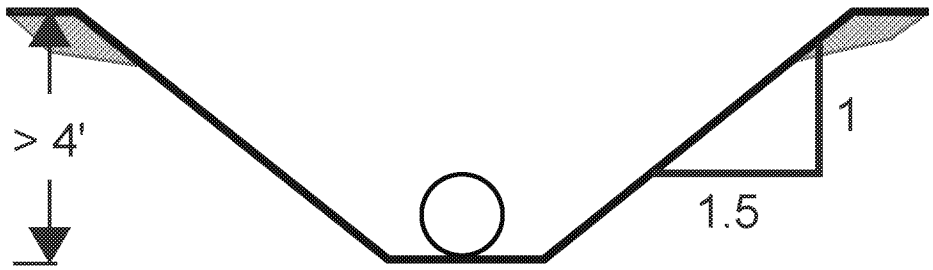
<u>At least two (2) potholes must be obtained for each utility within the work zone regardless of how small the work area is.</u>

Trench Shoring Methods

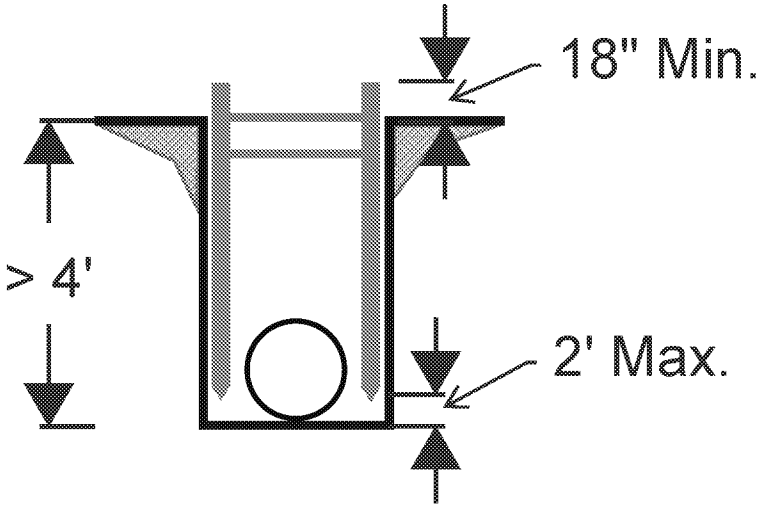
Pipe Depth: 4' or less
Shoring: None



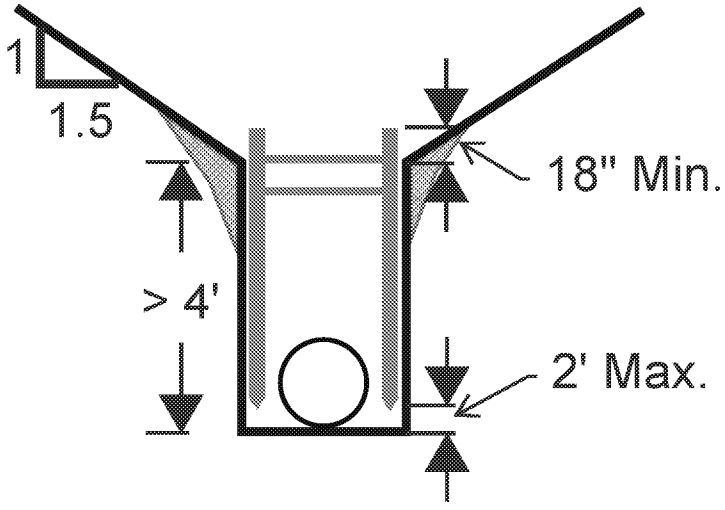
Pipe Depth: 4' or more
Shoring: None



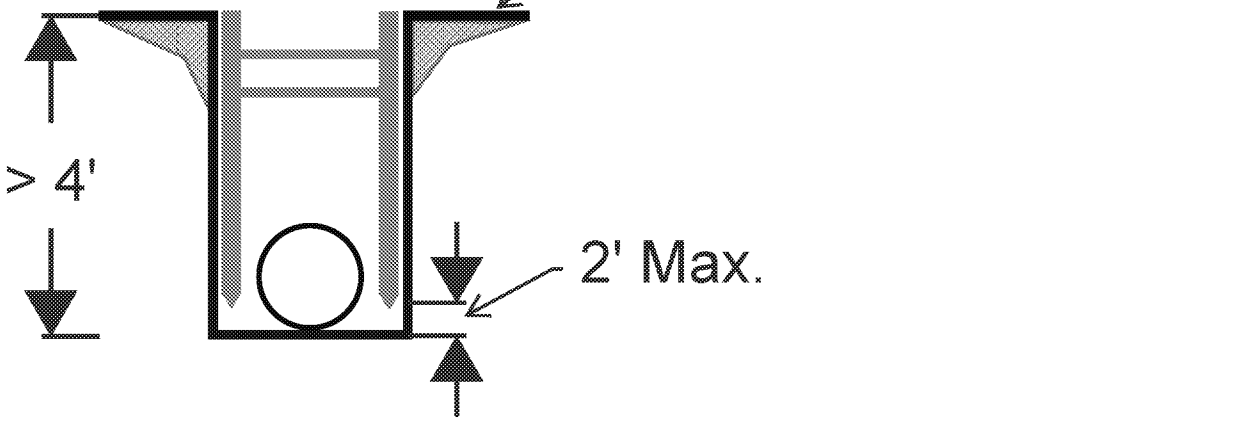
Pipe Depth: 4' or more
Shoring: Yes



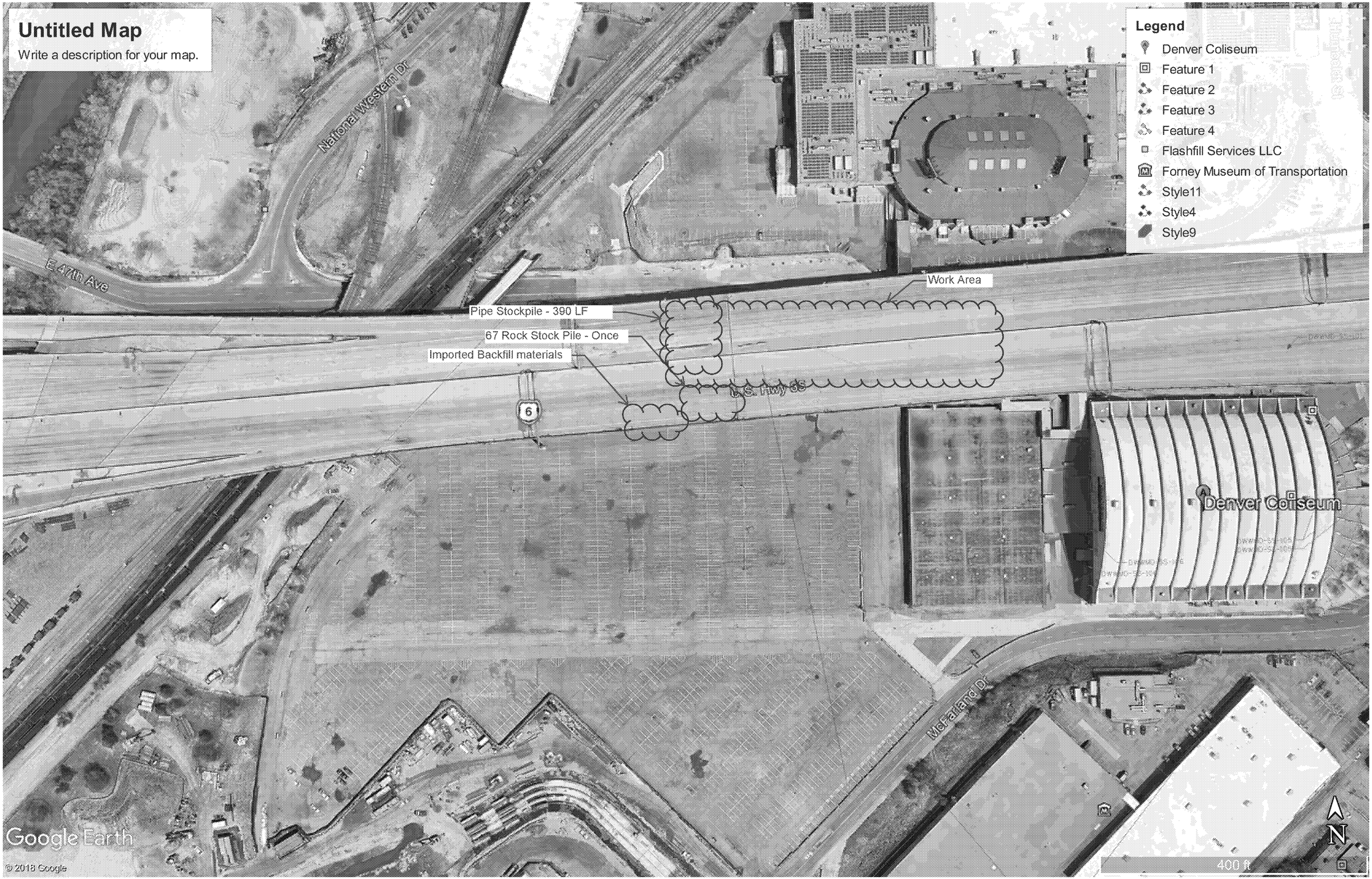
Pipe Depth: 4' or more
Shoring: Yes



Pipe Depth: 4' or more
Shoring: Yes



Site


Untitled Map
Write a description for your map.
Legend
Denver Coliseum
Feature 1
Feature 2
Feature 3
Feature 4
Flashfill Services LLC
Forney Museum of Transportation
Style11
Style4
Style9
National Western Dr
E 47th Ave
Work Area
Pipe Stockpile - 390 LF
67 Rock Stock Pile - Once
Imported Backfill materials
U.S. Hwy 85
6
Denver Coliseum
McFarland Dr
Google Earth
© 2018 Google
400 ft
N

Drawings

GENERAL NOTES:

1. CONTRACTORS PERFORMING WORK ON ANY WASTEWATER FACILITY OR APPURTENCE MUST BE PROPERLY LICENSED AND HAVE A LICENSED PLUMBER OR DRAIN LAYER ON SITE DURING THE WORK. (GENERAL CONTRACT CONDITIONS (G.C.C.) 317.1)

2. THE CURRENT EDITION OF THE WASTEWATER MANAGEMENT DIVISION STANDARD DETAILS SHALL APPLY TO ALL WORK AND WILL BE THE EDITION CURRENT AS OF THE ADVERTISEMENT DATE. THE CONTRACTOR MUST BE IN POSSESSION OF THE STANDARD DETAILS AT THE PRE-CONSTRUCTION CONFERENCE AND A COPY MUST REMAIN ON THE JOB SITE AT ALL TIMES DURING CONSTRUCTION. WASTEWATER MANAGEMENT DIVISION STANDARD DETAILS CAN BE OBTAINED AT WWW.DENVERGOV.ORG (SPECIAL CONTRACT CONDITIONS (SC-1), CONTRACT FORM - 8 (APPLICABLE LAWS))

3. THE CONTRACT SPECIFIED EDITION OF THE CITY AND COUNTY OF DENVER'S TRANSPORTATION STANDARDS AND DETAILS FOR THE ENGINEERING DIVISION SHALL BE FOLLOWED FOR ALL ROADWAY WORK IN THE PLAN SET AND WILL BE THE EDITION CURRENT AS OF THE ADVERTISEMENT DATE. THESE STANDARDS AND DETAILS CAN BE OBTAINED AT WWW.DENVERGOV.ORG (SC-1, CONTRACT CONDITIONS (SC-1), CONTRACT FORM 8) (APPLICABLE LAWS))

4. THE CONSTRUCTION ACTIVITIES STORMWATER DISCHARGE PERMITS (STATE AND LOCAL FLOODPLAIN PERMITS), STREET-CUT PERMIT, AND STREET OCCUPANCY PERMIT (INCLUDING THE ASSOCIATED TRAFFIC CONTROL PLANS) MAY BE REQUIRED AND IT IS THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN ALL OF THESE PERMITS. APPROVED COPIES OF ALL REQUIRED PERMITS MUST BE SUBMITTED TO THE CITY CONSTRUCTION PROJECT MANAGER PRIOR TO THE START OF CONSTRUCTION. (G.C.C. 301.2, 317.1 & 317.2 & 317.5; CONTRACT FORM 8 (APPLICABLE LAWS)

5. A PARKS PERMIT WILL BE REQUIRED FOR ANY WORK OR OCCUPANCY OF PARK LAND, THIS INCLUDES BUT IS NOT LIMITED TO: DESIGNATED CITY PARKS, PARKWAYS, OPEN SPACE, TRAILS AND BIKE PATHS. (301.2, 317.1 & 317.2 & 317.5; CONTRACT FORM - 8 (APPLICABLE LAWS)

7. "RED-LINED" DRAWINGS AND PRINTS ARE TO BE MAINTAINED BY THE CONTRACTOR AND SUBMITTED TO THE CITY CONSTRUCTION PROJECT MANAGER AT THE COMPLETION OF THE PROJECT. ANY AND ALL FIELD CHANGES MADE DURING CONSTRUCTION MUST BE NOTED. THE DRAWINGS WILL STATE "RED LINES" IN LARGE BLOCK LETTERS. THE RED-LINED DRAWINGS MUST BE RECEIVED AND ACCEPTED BY THE CITY CONSTRUCTION PROJECT MANAGER PRIOR TO FINAL ACCEPTANCE AND SETTLEMENT.

8. THE CONTRACTOR SHALL NOTIFY THE CITY CONSTRUCTION PROJECT MANAGER IMMEDIATELY OF "ANY" DISCREPANCIES OR VARIATIONS IN DRAWINGS & SPECIFICATIONS THAT AFFECT PRICING OR THAT COULD REQUIRE MODIFICATION TO THE DESIGN. (G.C.C.1103)

9. THE CITY AND COUNTY OF DENVER ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. THE UTILITIES SHOWN ON THESE DRAWINGS HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. ALL UTILITIES MUST BE LOCATED BY THE CONTRACTOR. ALL COSTS ASSOCIATED WITH FIELD VERIFICATION OF LOCATION AND DEPTHS OF UTILITIES SHALL BE BORNE BY THE CONTRACTOR AND SHALL BE COMPLETED PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION. (G.C.C. 701, 804)

10. ALL RANGE POINTS OR OTHER SURVEY MONUMENTS WHICH MAY HAVE BEEN DAMAGED OR DESTROYED DURING CONSTRUCTION SHALL BE TIED OUT AND RESET PER CITY SURVEYING STANDARDS. (G.C.C. 318, 319)

11. ALL ELEVATIONS SHOWN ARE NAVD88 DATUM, UNLESS OTHERWISE NOTED.

12. ALL SEWER MANHOLES MUST BE MAINTAINED AND ACCESSIBLE DURING CONSTRUCTION

13. ALL SANITARY MANHOLES ARE 4' DIAMETER WITH "A" BASE AND CONCENTRIC CONE UNLESS NOTED OTHERWISE.

14. ALL MANHOLES BUILT WITHIN THIS PROJECT SHALL INCLUDE EITHER A 4" OR 8" CAST IRON RISER WITH 3" STEEL ADJUSTING RINGS.

15. METRO WASTEWATER RECLAMATION DISTRICT MUST BE NOTIFIED AT LEAST 48 HOURS PRIOR TO CONSTRUCTION ON METRO FACILITIES IN ORDER FOR A DISTRICT INSPECTOR TO BE PRESENT DURING CONSTRUCTION. CONTRACTOR MUST CONTACT JIM MALLOREY, ENGINEERING TRANSMISSION SYSTEM DIVISION HEAD, AT 303-286-3487, OR JMALLOREY@MWRD.DST.CO.US, TO SCHEDULE THE INSPECTION.

DENVER WATER

IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO TAKE WHATEVER STEPS NECESSARY TO PROTECT ALL WATER FACILITIES. IF ANY WATER FACILITIES CANNOT BE ADEQUATELY PROTECTED, THEN SAID WATER FACILITIES SHALL BE RELOCATED OR REMOVED IN ACCORDANCE WITH THE DENVER WATER DEPARTMENT REQUIREMENTS, BY A DENVER WATER PREQUALIFIED CONTRACTOR.

CONSTRUCTION ACTIVITIES BY ANY PARTY THAT DISTURB, RELOCATE, SEVER, OR IN ANY OTHER WAY IMPACT A SERVICE LINE SHALL BE REQUIRED TO MEET CURRENT DENVER WATER REQUIREMENTS FOR SERVICE LINES AS SPECIFIED IN CHAPTER 3 OF THE LATEST DENVER WATER STANDARDS. IN THE EVENT LEAD WATER LINES ARE ENCOUNTERED, DO NOT DISTURB, IMMEDIATELY STOP WORK, AND NOTIFY THE CITY CONSTRUCTION PROJECT MANAGER.

C70 DATUM STATEMENT:
BASIS OF BEARING: BEARINGS USED IN THE CALCULATIONS OF COORDINATES ARE BASED ON A GRID BEARING OF N86° 24'06"W BETWEEN NGS MONUMENT "PENA" (PID# AE5246), BEING A STAINLESS STEEL ROD IN MONUMENT BOX, TO NGS MONUMENT "B 394" (PID# KK1294), BEING A VERTICAL CONTROL DISK IN A CONCRETE ABUTMENT STAMPED "B 394 -1983".
THE SURVEY DATA WAS OBTAINED FROM A GLOBAL POSITIONING SYSTEM (GPS) SURVEY BASED ON THE COLORADO HIGH ACCURACY REFERENCE NETWORK (CHARN).
SAID GRID BEARING IS NAD 83(1992) UNIVERSAL TRANSVERSE MERCATOR (UTM) ZONE 13 NORTH.

BASIS OF ELEVATION: PROJECT ELEVATIONS ARE BASED ON NGS MONUMENT "B 394" (PID# KK1294) BEING A VERTICAL CONTROL DISK SET IN THE SOUTH BRIDGE ABUTMENT AT THE I-70/COLORADO BOULEVARD INTERCHANGE, HAVING A PUBLISHED NAVD 88 ELEVATION OF 5261.82 FT. ELEVATIONS SHOWN HEREIN WERE GPS DERIVED THROUGH COMPLETION OF A STATIC GPS NETWORK SURVEY USING GEOID12A.

COORDINATE DATUM: PROJECT COORDINATES ARE MODIFIED UNIVERSAL TRANSVERSE MERCATOR (UTM) ZONE 13 NORTH NAD 83(1992) COORDINATES. THE COMBINED ELEVATION/SCALE FACTOR USED TO MODIFY THE COORDINATES FROM UTM TO PROJECT COORDINATES IS 1.0006504025. THE RESULTING PROJECT COORDINATES ARE TRUNCATED BY 14,000,000' IN THE NORTHING AND 1,000,000' IN THE EASTING AFTER CONVERTING FROM UTM COORDINATES TO PROJECT COORDINATES. UNITS ARE US SURVEY FEET.

PROJECT SPECIFIC NOTES:

1. ELEC, GAS, WATER, FIBER OPTIC, TELEPHONE AND OTHER DRY UTILITIES ARE AT ASSUMED ELEVATIONS UNLESS NOTED OTHERWISE
2. LABELS FOR EXISTING FEATURES ARE DISPLAYED IN ITALICS
3. SEE ABANDONMENT SHEETS FOR ABANDONMENT DETAILS OF EX SANITARY
4. PIPE LENGTHS SHOWN IN PROFILE ARE EDGE OF STRUCTURE TO EDGE OF STRUCTURE

DELGANY COMMON INTERCEPTOR:

CONSTRUCTION ACTIVITY IS ANTICIPATED TO OCCUR IN THE GENERAL VICINITY OF THE HISTORIC DELGANY COMMON INTERCEPTOR AS IDENTIFIED IN THE CENTRAL 70 PROJECT FEIS (5DV4725). THE CONTRACTOR SHALL TAKE APPROPRIATE MEASURES TO AVOID IMPACTS TO THIS FACILITY.

COLORADO LICENSED
JON N. ANDRESEN JR.
35118
Jon N Andresen Jr
2018.10.05
16:29:57 -06'00'
PROFESSIONAL ENGINEER

9/24/2018 21430PUT_GN-SN50.002.dgn Kiewit meridiam PARTNERS	RELEASED FOR CONSTRUCTION Central 70	0.0	Sheet Revisions Date: 10-05-18 Comments: RFC SAN SEWER 5.0 Init.: JNA	Colorado Department of Transportation CDOT 2829 W. Howard Pl. Denver, CO 80204 Phone: 303-757-9011 FAX: 303-757-9866 Headquarters KJS	As Constructed No Revisions: Revised: Void:	CENTRAL 70 SANITARY SEWER PACKAGE 5 SANITARY GENERAL NOTES Designer: KB Detailer: KB Subset: SANITARY 05	Structure Numbers Subset Sheets: 2 of 11	Project No./Code C 0704-241 21430 Sheet Number SN50.002	

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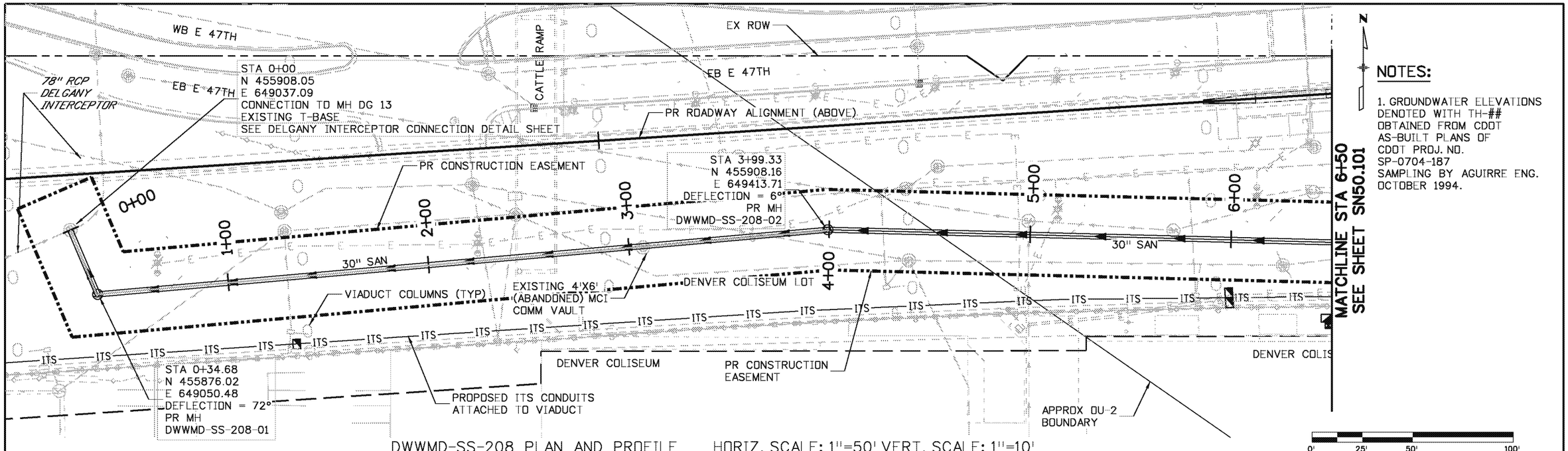

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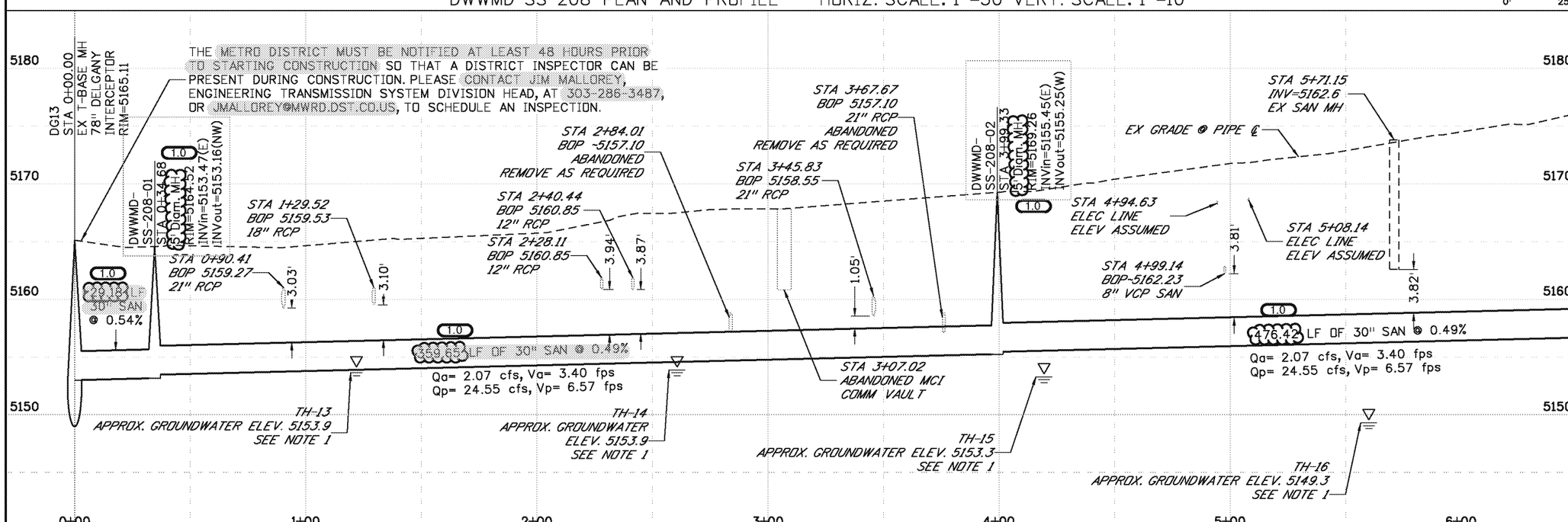

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Denver, CO 80204
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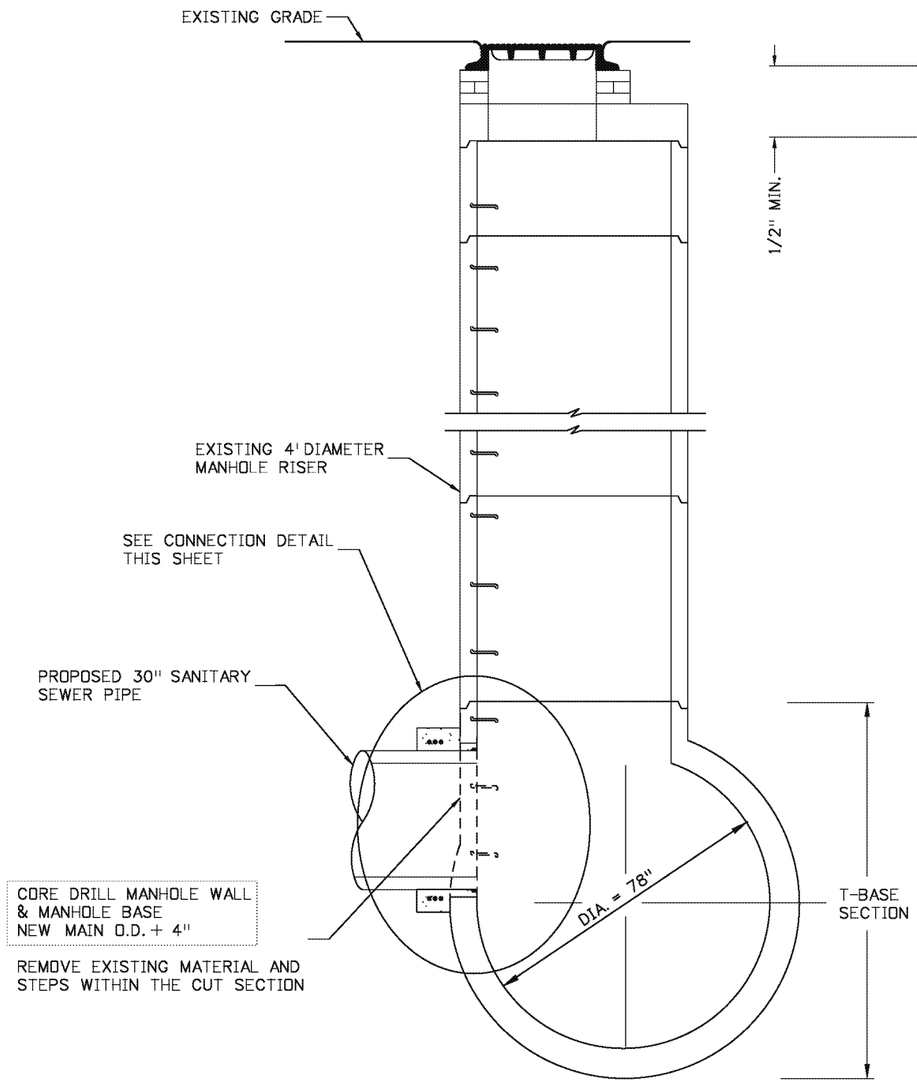

PROPOSED 30" SANITARY CONNECTION DETAIL AT EXISTING DELGANY MANHOLE (T-BASE)
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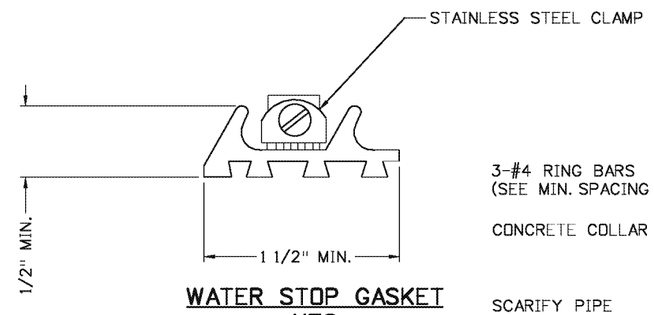

WATER STOP GASKET
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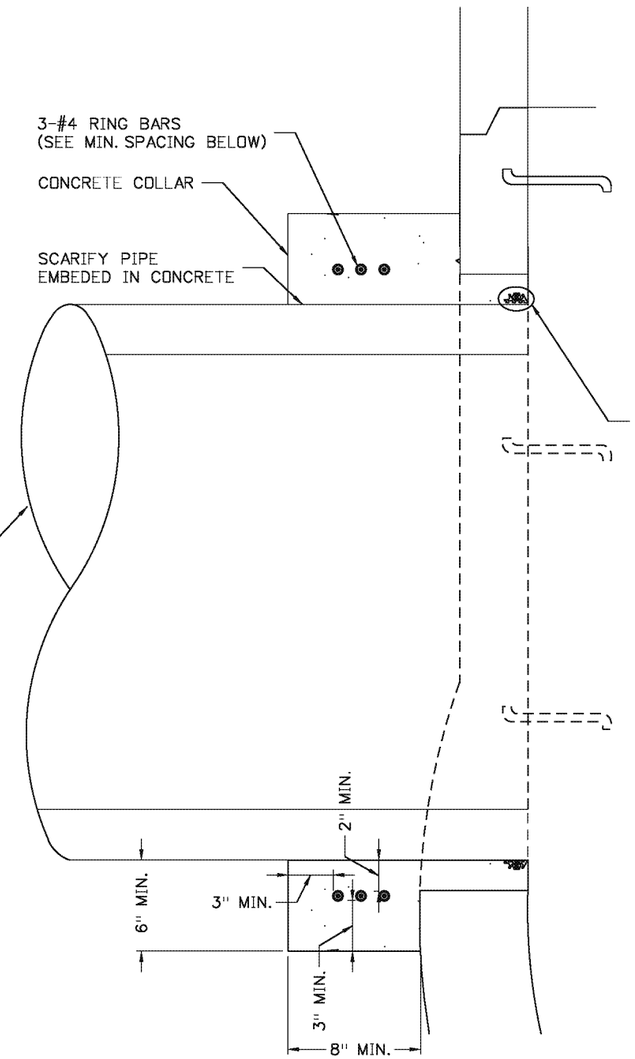

PROPOSED 30" SANITARY PIPE CONNECTION DETAIL AT EXISTING MANHOLE (T-BASE)
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NOTES:

1. THE METRO DISTRICT MUST BE NOTIFIED AT LEAST 48 HOURS PRIOR TO STARTING CONSTRUCTION SO THAT A DISTRICT INSPECTOR CAN BE PRESENT DURING CONSTRUCTION. PLEASE CONTACT JIM MALLOREY, ENGINEERING TRANSMISSION SYSTEM DIVISION HEAD, AT 303-286-3487, TO SCHEDULE AN INSPECTION.

WATER STOP GASKET
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WATER STOP GASKET SHALL BE PLACED ON NEW PIPE IN LINE WITH EXISTING MANHOLE OR PIPE WALL AT THE LOCATION OF THE CONNECTION. CONCRETE GROUT OVER THE WATER STOP GASKET TO FILL IN THE VOID AROUND THE PIPE FROM THE CORE DRILLED HOLE.

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Attachment 3: Materials Management Plan

MATERIALS MANAGEMENT PLAN - OPERABLE UNIT (OU) 2

CENTRAL 70, DENVER, CO

RECORD OF REVISIONS

Revision number	Date issued	Pages affected	Comments
0	08/17/2018	All	Initial submission
1	08/27/2018	8	KMP comments incorporated
2	2/13/2019	All	CCD/CDOT comments incorporated
3	3/29/2019	All	CCD/CDOT comments incorporated
4	4/29/2019	13 & 17	CCD/CDOT comments incorporated

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TABLE OF CONTENTS

1.0 INTRODUCTION 5

2.0 PROJECT INFORMATION AND BACKGROUND 5

2.1 Location and Description of Project 5

2.2 Target Analyte List and Comparison Criteria 6

2.2.1 Soil Target Analyte List and Comparison Criteria 6

2.2.2 Groundwater and Stormwater Target Analyte List and Action Levels 6

2.2.3 Wastewater/Impacted Water Target Analyte List and Action Levels 7

2.3 Recognized Hazardous Materials Classifications 7

2.3.1 Soil RHM Classifications 7

2.3.2 Groundwater and Stormwater RHM Classifications 7

2.3.3 Wastewater/Impacted Water Classifications 7

2.4 Hazardous Waste Disposal 8

3.0 TRAINING REQUIREMENTS 8

3.1 Key Individuals and Roles 8

3.1.1 Environmental Manager 8

3.1.2 KMP Site Health and Safety Officer 9

3.1.3 Compliance Manager/RHM Manager 9

3.1.4 Monitoring Technician 9

3.2 Safety and Health Training Program 9

3.3 Hazardous Waste Operations and Emergency Response Training 10

3.4 First Aid 10

3.5 Asbestos Awareness Training 10

3.6 Site Specific Training 10

3.7 Key Personnel Qualifications 11

3.7.1 CM/RHM Manager 11

3.7.2 Monitoring Technician 11

3.8 Visitor Training 12

4.0 RECOGNIZED HAZARDOUS MATERIALS CLASSIFICATION EVALUATION 12

4.1 Field Screening of Soil, Groundwater, and StormWater 12

4.2 Temporary Material Segregation Procedures 13

4.3 Transportation Procedures 14

4.4 Sampling and Analysis of RHMs Requiring Further Characterization 14

4.4.1 Analytical Parameters and Methods for Soil 14

4.4.2 Sampling of Potentially Impacted Groundwater 14

4.4.3 Analytical Parameters and Methods for Groundwater 15

4.5 Comparison to Action Levels 15

4.5.1 Soil Comparison Criteria 15

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4.5.2 Comparison to Groundwater Disposal Criteria 16
4.6 Quality Control Requirements 17
5.0 IMPORT FILL REQUIREMENTS 17
6.0 PROJECT DOCUMENTATION 17
7.0 PLAN AMENDMENTS 18
8.0 DELIVERABLE CERTIFICATION 18
9.0 REFERENCES 18

APPENDICES

Appendix A OU2 Area Map
Appendix B OU2 Drawings
Appendix C Target Analyte Comparison Criteria
Appendix D Monthly Statement of Recognized Hazardous Materials Management Template
Appendix E DDPHE Memo regarding work in the Vasquez Boulevard and I-70 Superfund site
Appendix F *Beneficial Reuse and Materials Management Plan, CDOT Central 70 Project*, dated September 12, 2017 (Includes CDOT RACS SOP)

TABLES

Table 1 Pre-Approved Beneficial Use Materials

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ACRONYMS

ACM – Asbestos Containing Material
AED – Automated External Defibrillator
APCD – Air Pollution Control Division
APEN – Air Pollution Emission Notice
BRMMP – Beneficial Reuse and Materials Management Plan
CCR – Code of Colorado Regulations
CCD – City and County of Denver
CDOT – Colorado Department of Transportation
CDPHE – Colorado Department of Public Health and Environment
CFR – Code of Federal Regulations
CM – Compliance Manager
COC – Contaminant of Concern
CPR – Cardiac Pulmonary Resuscitation
CSI – Conservation Services, Inc.
DADS – Denver Arapahoe Disposal Site
DDPHE – Denver Department of Health and Environment
EPA – U.S. Environmental Protection Agency
GPS – Global Positioning System
GPV – Groundwater Protection Value
HASP – Health and Safety Plan
HAZWOPER – Hazardous Waste Operations and Emergency Response
HSO – Health and Safety Officer
KMP – Kiewit Meridiam Partners
MMP – Materials Management Plan
MT – Monitoring Technician
OSHA – Occupational Safety and Health Administration
OU2 – Operable Unit 2
PCB – Polychlorinated biphenyl
PID – Photoionization detector
PLM – Polarized-Light Microscopy
RACS – Regulated Asbestos Contaminated Soil
RBSL – Risk-Based Screening Level
RCRA – Resource Conservation and Recovery Act
RHM – Recognized Hazardous Material
RSL – Regional Screening Level
RSL-I – Regional Screening Level – Industrial
RSL-R – Regional Screening Level – Residential
SAP – Sampling and Analysis Plan
SVOC – Semi-Volatile Organic Compounds
TCLP – Toxicity Characteristic Leachate Procedure
TPH – Total Petroleum Hydrocarbons
TSS – Total Suspended Solids
TS – Total Solids
VOC – Volatile Organic Compounds

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1.0 INTRODUCTION

Kiewit Meridiam Partners (KMP) developed this Materials Management Plan (MMP) for construction activities that are a part of the Central 70 Project but occur specifically within the boundaries of Operable Unit 2 (OU2). This MMP is intended to provide procedures to handle, store, dispose, and track Recognized Hazardous Materials (RHMs) present in soil, groundwater, comingled stormwater, and wastewater or impacted water encountered during the construction operations associated with this work.

The primary focus of this document is to ensure proper management, disposal, and tracking of RHMs in OU2 by defining handling requirements for disposal of excavated soil and dewatered groundwater and comingled stormwater. This MMP for OU2 complies with the Colorado Department of Transportation's (CDOT) Preliminary Beneficial Reuse and Materials Management Plan (BRMMP) dated September 12, 2017 and federal and state regulations.

Construction operations to occur within OU2 include installation of approximately 400 lineal feet of sanitary sewer to be tied into the existing Delgany Interceptor and associated excavation and backfill. The activities that this MMP for OU2 addresses are as follows:

1. Evaluation and classification of soils (including associated asphalt, concrete, and road base); dewatering groundwater and comingled stormwater; and wastewater/impacted water.
2. Proper handling, stockpiling, and transporting of classified soils (including associated asphalt, concrete, and road base); dewatering groundwater and comingled stormwater; and wastewater/impacted water.
3. Training Requirements.
4. Disposal of classified soils (including associated asphalt, concrete, and road base); and dewatering groundwater and stormwater.
5. Import fill requirements.
6. Documentation and reporting.

This MMP for OU2 is used in conjunction with the Project Health and Safety Plan (HASP) and Sampling and Analysis Plan (SAP) for OU2 when managing RHMs.

2.0 PROJECT INFORMATION AND BACKGROUND

This section describes the general location of the Project, environmental history, information available regarding potential soil and groundwater impacts, and comparison criteria applicable to the Project in the OU2.

2.1 Location and Description of Project

The Project is located along the I-70 corridor between I-25 and Chambers Road in Denver and Adams Counties, in Denver, Colorado. The Project is surrounded by residential, commercial, and industrial areas. The Project consists of reconstructing a 10-mile segment of I-70 east of downtown Denver; reconstructing I-70 from Brighton Boulevard to I-270, including adding one express lane in each direction, removing the 53-year old viaduct, and lowering the interstate between Brighton Boulevard and Colorado Boulevard; constructing a 4-acre cover park over a portion of the lowered interstate; and widening I-70 from I-270 to Chambers Road to add one express lane in each direction.

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OU2 is a defined area within the Vasquez Boulevard and I-70 Superfund site (VB/I-70) located in northeast Denver near the Project corridor (Appendix A). Historically, the area was a major smelting center with two smelting plants refining gold, silver, copper, lead, and zinc. As a result, heavy metals were deposited in area soils at levels that posed a health risk for people living there. Groundwater was also impacted at these former smelter locations. In addition, the Denver Coliseum parking lot, within OU2 boundaries, is the site of the 1950s-era Denver municipal landfill where known asbestos containing materials have been identified.

The only construction operations related to the Project that occur within the OU2 boundaries is the replacement of the sanitary sewer line as previously discussed. Work activities include excavation and removals, installation of the new sanitary sewer with associated tie-in, and restoration of the work area (Appendix B).

2.2 Target Analyte List and Comparison Criteria

Based on known history of the OU2 area and potential contaminants of concern, KMP has determined that all soil that is excavated for purposes of installing the sanitary sewer will be disposed of offsite. All encountered groundwater that needs to be discharged from the excavation will also be captured and disposed of offsite. All soils will be taken to Waste Management's Denver Arapahoe Disposal Site (DADS) and groundwater will be taken to the solidification basin at Conservation Services Inc. (CSI) Landfill (also owned by Waste Management). Soil and groundwater will be sampled for disposal purposes only and sampling will be performed in accordance with parameters required by both landfills. Sampling data will be provided to Waste Management for review prior to hauling soil or groundwater offsite. KMP will procure waste profiles for these materials on behalf of CDOT as the generator. This MMP describes the disposal criteria to be used for compliance with Waste Management's sampling requirements for both soil and groundwater. A list of the analytes and numerical soil comparison criteria is described below and included as Appendix C.

2.2.1 Soil Target Analyte List and Comparison Criteria

CDOT established the following soil target analyte list for the Project, which are consistent with known contaminants of concern at OU2:

- Polycyclic Aromatic Hydrocarbons (PAHs).
- Resource Conservation and Recovery Act (RCRA) 8 metals (i.e. arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver).
- Volatile Organic Compounds (VOCs).
- Asbestos
- Additional analytes, if required for further waste disposal characterization or if warranted by field screening.

2.2.2 Groundwater and Stormwater Target Analyte List and Action Levels

Groundwater (and comingled stormwater) is anticipated to be dewatered. Groundwater and comingled surface water dewatering target analytes are consistent with known contaminants of concern:

- Polychlorinated Biphenyls (PCBs).
- RCRA 8 metals.
- VOCs.

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- SVOCs.
- Total suspended solids (TSS).
- Total solids (TS).
- Total petroleum hydrocarbons (TPH).
- Field pH.
- Additional analytes, if required for further waste disposal characterization or if warranted by field screening.

Groundwater will be dewatered into onsite frac tanks within the limits of the operation. Water will be sampled from the tanks prior to disposal.

2.2.3 Wastewater/Impacted Water Target Analyte List and Action Levels

If encountered, the Compliance Manager (CM)/RHM Manager or Monitoring Technician (MT) will select analytical parameters for the process water or potentially impacted water that is identified, and as required by the off-site disposal facility. Results will be compared to disposal facility acceptance criteria and maximum concentration of contaminants for the toxicity characteristic.

2.3 Recognized Hazardous Materials Classifications

Based upon the above listed target analyte lists and comparison criteria, and following the procedures described in Section 4 for field screening and sampling and analysis, KMP characterizes and classifies RHMs into the following categories, with the understanding that within OU2, all excavated materials will be disposed of offsite. All RCRA non-hazardous materials will be disposed of at DADS for soil and at CSI for ground water.

2.3.1 Soil RHM Classifications

- Solid waste (e.g. buried waste material) requiring off-Site disposal and/or treatment.
- Soils requiring further characterization.
- Soils identified as Regulated Asbestos Contaminated Soil (RACS)
- Hazardous waste, as defined under the RCRA, requiring off-site disposal and/or off-site treatment.

2.3.2 Groundwater and Stormwater RHM Classifications

- Groundwater (and comingled stormwater) requiring further characterization for off-site disposal and/or treatment.
- Hazardous waste, as defined under the RCRA, requiring off-site disposal and/or off-site treatment.

2.3.3 Wastewater/Impacted Water Classifications

- Wastewater requiring off-site disposal and/or treatment.
- Impacted water to be held for further characterization.

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2.4 Hazardous Waste Disposal

In the instance that any of the samples collected for soil or groundwater exceed non-hazardous disposal criteria, the material will be handled as hazardous waste and disposed of accordingly. Hazardous waste will be taken to Clean Harbors' Deer Trail Landfill. Additional sampling may be completed as necessary to complete a profile and fully characterize the soil or groundwater for disposal at this location.

3.0 TRAINING REQUIREMENTS

The Colorado Solid Waste Regulation 6 CCR 1007-2 and the Occupational Safety and Health Administration (OSHA) Standard 29 Code of Federal Regulations (CFR) 1926.1101 outline training requirements and worker protection standards for activities that involve waste materials and asbestos. Personnel with responsibilities under this plan are trained in accordance with the Project HASP. KMP will be utilizing a licensed and trained subcontractor to complete the sanitary sewer line work within OU2.

KMP provides licensed and appropriately trained field personnel, including a CM/RHM Manager and MT, to oversee material segregation and stockpiling; perform RHM classification; oversee soil placement; and other related activities, as described below.

3.1 Key Individuals and Roles

The following table identifies key personnel responsible for implementation of this management plan.

Table 1: MMP Contacts

Title	Name	Company	Phone Numbers	Email Address
CDOT Environmental Project Manager	Tim Buntrock	CDOT	(303) 404-7043	Timonthy.buntrock@state.co.us
CDOT Recognized Hazardous Materials Manager	Scott Epstein	Pinyon Environmental	(303) 594-2862	epstein@pinyon-env.com
Environmental Manager	Megan Wood	Kiewit Infrastructure	(970) 819-8147	Megan.Wood1@kiewit.com
KMP Site Health and Safety Officer	Ron Crandall	Foothills Environmental	(720) 254-0279	Ron@foothillsusa.com
Compliance Manager/RHM Manager	Laura Tobin	WSP	(303) 726-8100	Laura.Tobin@wsp.com
Monitoring Technician	Andrew Umyn	Iron Woman	(303) 947-6453	AUmyn@ironwomancon.com

3.1.1 Environmental Manager

The Environmental Manager is responsible for overseeing the Project environmental program and for overall compliance with this MMP. The Environmental Manager oversees the Site Health and Safety Officer (HSO), CM/RHM Manager, and Monitoring Technician (MT). The Environmental Manager or designee is also responsible for overseeing the abatement subcontractors, testing labs, and other associated personnel necessary to properly manage RHMs in accordance with this plan.

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3.1.2 KMP Site Health and Safety Officer

The KMP HSO is responsible for protection of workers implementing this MMP. Training requirements and responsibilities for the HSO are detailed in the HASP.

3.1.3 Compliance Manager/RHM Manager

The CM and RHM Manager roles are filled by a single individual, who is primarily responsible for ensuring that RHMs are properly classified, handled, and disposed. This includes the following responsibilities:

- Implementation of the MMP
- Ensuring KMP follows environmental requirements applicable to RHMs
- Field screening of soils
- Collection of samples and classification of RHMs
- Oversight of truck loading, transportation
- Ensuring material disposal in accordance with sample results
- Monitoring of compliance with regulations, the Project HASP, and this plan
- Immediate notification to Environmental Manager and the Site Health and Safety Officer of any hazardous condition
- Oversight of MTs

3.1.4 Monitoring Technician

The MT is primarily responsible for conducting onsite field monitoring, including the field screening and sampling described in this plan. The CM/RHM Manager may delegate any of their responsibilities to the MT. Either the CM/RHM Manager or MT is available during soil-disturbing activities. The MT is onsite during soil-disturbing activities, unless the CM/RHM Manager determines that no impacted materials are likely to be encountered (for example if excavation and install is complete and only backfill remains). Either the CM/RHM Manager or MT is onsite during field screening, sample collection, and loading of RHMs.

3.2 Safety and Health Training Program

Several levels of health and safety training are required per OSHA, EPA, and State of Colorado regulations for personnel participating in the implementation of field activities. Site workers will be required to follow the provisions of the Project's HASP, OSHA regulations under 29 CFR 1926, Colorado Department of Public Health and Environment (CDPHE) regulations, and any additional instructions of the Health and Safety Officer (HSO).

All MTs, and any other Site workers, involved in the OU2 construction activities must have current training documentation for the following before field activities commence:

- 24-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training.
- 40-hour HAZWOPER training when on uncontrolled hazardous waste sites.
- Current 8-hour refresher certificates.

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- First-aid, cardiopulmonary resuscitation (CPR) and external defibrillator (AED) training.
- 2-Hour Asbestos Awareness Training.

Additionally, a Certified Asbestos Building Inspector trained and certified in accordance with Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B) will be present during soil excavation activities.

Documentation of this training will be maintained by the Environmental Manager.

3.3 Hazardous Waste Operations and Emergency Response Training

Personnel working on uncontrolled hazardous waste sites where potential to exceed OSHA PELs for respective site contaminants of concern (COCs) may occur are required to have 40-hour HAZWOPER training. The training program must comply with the requirements of 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training program includes:

- Names of personnel and alternates responsible for site safety and health.
- Safety, health and other hazards present on the site.
- Use of personal protective equipment.
- Work practices by which the employee can minimize risks from hazards.
- Safe use of engineering controls and equipment on the site.
- Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards.
- Elements of a HASP.

3.4 First Aid

For specific work tasks related to site COCs in accordance with OSHA requirements, the MT and specified KMP and KIC personnel are required to have current American Red Cross and/or American Heart Association Heartsaver® certifications in first aid, CPR, and use of an AED. Furthermore, the location of the nearest medical facility, the directions from the Site to the facility, and the telephone number of the facility and the local rescue facility are provided in the Project's HASP.

3.5 Asbestos Awareness Training

Each employee involved in construction activities related to OU2 operations is required to attend the two-hour asbestos awareness training provided by KMP prior to conducting field work. The awareness training educates each employee regarding the hazards of asbestos and how to identify potential asbestos containing materials in soils. Each trainee is issued a certificate of completion and a sticker for their hardhat that verifies they have attended the training.

3.6 Site Specific Training

Daily safety briefings will be held by the respective contractor prior to initiating any site activity and more frequently as necessary to ensure that employees are apprised of the site hazards and that the Site HASP is being followed. Furthermore, site personnel shall be trained on potential health and safety issues, protective equipment, emergency information and supplies, and to discuss special topics. In addition, each field team will complete a job hazard analysis (JHA) prior to initiating Site activities that lists the procedures for completing the job and identifies the hazards, which will be signed by each employee. Each employee is required to attend the KMP one-hour Site safety training prior to working onsite.

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3.7 Key Personnel Qualifications

3.7.1 CM/RHM Manager

KMP has designated a CM/RHM Manager who meets at least one of the following criteria:

- Holds a current certification/license as a Professional Geologist issued by a state licensing body, the American Institute of Professional Geologists, or the National Association of State Boards of Geology
- Holds a current certification/license as a Professional Engineer issued by the State of Colorado or a reciprocal state licensing agency
- Holds a current certification as an Environmental Professional issued by the Academy of Board Certified Environmental Professionals
- Holds a current designation as a Registered Environmental Professional by the Colorado Department of Labor and Employment, Division of Oil and Public Safety

Additionally, the CM/RHM Manager has the following qualifications:

- Completed the Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and current 8-hour annual refresher
- Completed the OSHA eight-hour Supervisory training
- Completed the DOT Hazardous Materials Training (US DOT Regulation 49 CFR 172.704)
- Is a Qualified Project Monitor (QPM) as defined by Section 5.5.3 of 6 CCR 1007-2, Part 1, or has completed 2-hour asbestos in soil awareness training and has direct access to a QPM

3.7.2 Monitoring Technician

The CM/RHM Manager may delegate responsibilities to MTs who have the following minimum qualifications:

- A bachelor's degree from an accredited institution in geology, engineering, environmental science, or another related field
- Completed the OSHA 40-hour HAZWOPER training and current 8-hour annual refresher
- Be a Colorado Asbestos Building Inspector (CABI) and meet the criteria of a QPM
- Be properly trained in standard methods for soil screening, sample collection, and sample handling
- KMP has designated a MT who meets the above minimum qualifications and possesses the following additional qualifications:
- Has 2 years of field experience in assessment and remediation of hazardous substances that may be encountered during highway construction projects
- Is experienced in the operation of monitoring devices, identifying substances based on experience and observation, and field sampling of soil and groundwater
- Has completed the OSHA 40-hour HAZWOPER training, current 8-hour annual refresher, and 8-hour supervisory training

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3.8 Visitor Training

All visitors to the active work areas will be briefed by the HSO or MT on health and safety procedures to be followed. The visitors will be provided the HASP to review and will sign a certification that the plan has been provided, reviewed, and understood before visitors enter an active work area. Access to the OU2 area will be restricted to visitors with the appropriate training and personal protective equipment (PPE).

The Superintendent and Foreman will control visitor entry to the active work areas. No visitor will enter these areas without previously notifying the Superintendent or Foreman or their designee of the visit. KMP and KIC site supervisors, contractor supervisors, or designated safety personnel, HSO or MT will ensure that all visitors have the proper level of PPE for downrange activities and training in the use of the equipment. Visitors who do not have the appropriate training will not be permitted in areas where the use of PPE is required.

4.0 RECOGNIZED HAZARDOUS MATERIALS CLASSIFICATION EVALUATION

KMP will complete initial field screening for the OU2 work operations prior to beginning construction by completing sampling and analytical testing for RHMs as listed in this MMP and as further identified during field screening. These analytical results will be compared to the provided comparison criteria to properly classify the RHMs prior to offsite disposal. Further details on sampling can be found in the Sampling and Analysis Plan for OU2.

4.1 Field Screening of Soil, Groundwater, and Stormwater

If during the course of excavation, RHMs are encountered based on visual observation that were not previously identified in the sampling, KMP stops work until the CM/RHM Manager or MT is able to complete field screening and direct additional sampling as required.

The CM/RHM Manager and MT are responsible for field screening. The CM/RHM Manager or MT oversees excavation at each soil disturbing face. The most prevalent contaminants within the OU2 work area are arsenic, lead, VOCs, PAHs, and potentially friable asbestos. In general, these contaminants cannot be easily screened using field instrumentation. Therefore, field screening follows visual and olfactory indicators for contamination (i.e., "looks bad, smells bad" parameters), as outlined below, in addition to standard use of a PID.

Field screening includes, at a minimum, the following "looks bad, smells bad" parameters:

- Visual staining, including greying (i.e. gray material, indicating reducing subsurface conditions), or dark coloration.
- Presence of non-soil materials (e.g., debris, sludge, powders, coal-based fill).
- Presence of paint chips.
- Presence of suspect ACM.
- Coatings or paint on asphalt or concrete.
- Evidence of dumping.
- Presence of distinguishable odor.
- Discrete layers in a soil cross-section that generally appear out of place.

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- Visual sheen on dewatering groundwater (and comingled stormwater).

In the absence of any visual, olfactory, or PID indication that contamination may be present, the following materials may be classified without further characterization (i.e. without sampling and analysis):

- Asphalt, Concrete, and Road Base

These materials may be classified by the CM/RHM Manager as non-impacted/unrestricted reuse and recycled and reused in accordance with CDOT standard specifications and the CDPHE Pre-Approved Beneficial Use Table.

All other materials, if there is a visual, olfactory, or PID indication that contamination may be present, are classified as RHMs requiring further characterization for disposal. Additional characterization is completed, as described in Section 4.4.

4.2 Temporary Material Segregation Procedures

If the CM/RHM Manager or MT identifies a visual, olfactory, or PID indication of potential contamination that was not identified in the pre-construction sampling, the material may be temporarily segregated, stockpiled, or containerized by criteria, such as type of impact, likely contaminants, and soil type, and in accordance with the following procedures:

- Whenever possible, handling is completed by mechanical means, including the use of mechanized excavation equipment.
- Materials containing different potential contaminants are placed in separate containers or stockpiles.
- Stockpiles and containers are prohibited from being diluted or mixed.
- If soil must be stockpiled, it is placed on minimum 6-mil plastic sheeting as well as covered and anchored with plastic.
- Stormwater controls are installed around stockpiles to prevent runoff.
- Stockpiles are evaluated for potential windblown impact and mitigated as necessary.
- If soils are stockpiled, all stockpiles will be limited to placement within the OU2 boundaries

Stockpiles with suspected or confirmed Regulated Asbestos Contaminated Soil (RACS) are managed in accordance with 6 CCR 1007-2 and

- Adequately wet during disturbance.
- Stabilized with polyethylene sheeting or geotechnical fabric, with a chemical stabilizer (e.g. magnesium chloride), or with a minimum of 3 inches of soil appropriate for unrestricted use.
- Sheeting, fabric, or soil cover is inspected daily and no later than 12 hours following storm events.
- Sheeting, fabric, or soil cover is repaired/replaced as necessary to maintain stabilization.
- Chemical stabilizer is inspected no later than one calendar day after storm events and is reapplied as necessary to maintain stabilization.
- Stockpiles with suspected or confirmed RACS stored more than ten calendar days require the submission of a RACS Storage Plan. Storage of RACS shall not commence prior to approval of the RACS Storage Plan by CDPHE's Hazardous Materials and Waste Management Division.
- The ground surface around stockpiles is graded to drain toward the edge of the stockpiles, and the berm or trench around stockpiles is covered by plastic sheeting.

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- Stockpile and container storage areas are clearly delineated to prevent contact with unauthorized personnel.

KMP will utilize CDOT's approved RACS Management Standard Operating Procedure (provided in Appendix F) to comply with Colorado Solid Waste Regulations CCR 1007-2 Part 1, Section 5.5 (Colorado Solid Waste Regulation [CSWR] §5.5; CDPHE, 2014).

4.3 Transportation Procedures

Transportation and manifesting of waste materials on public highways, streets, or roadways is conducted in accordance with federal, state, and local requirements. KMP documents and submits to CDOT the appropriate type and amount of insurance required by laws and regulations governing the transportation of hazardous waste, if hazardous waste is transported. KMP marks and labels containers with the required labels specified by federal Department of Transportation (DOT) regulations for shipping hazardous materials as listed under 40 CFR 172. KMP ensures the transporter's vehicle is properly placarded in compliance with applicable DOT hazardous material regulations. KMP ensures the shipper of the materials is trained and tested in accordance with the hazardous material transportation requirements prescribed in 49 CFR 172, Subpart H. KMP completes manifests or bills of lading in compliance with regulations and secure an EPA ID number. KMP utilizes CDOT-approved vendors for transportation of RHMs.

4.4 Sampling and Analysis of RHMs Requiring Further Characterization

Soil sampling will be completed within the OU2 work area to classify RHMs prior to the start of construction. If potentially contaminated soil, or dewatering groundwater/comingled stormwater, is encountered, as identified through field screening, the CM/RHM Manager or MT records the global positioning system (GPS) coordinates of the RHM and collects samples for laboratory analysis following the procedures as outlined below and further described in the SAP. CDOT and the CM/RHM Manager or MT compares the analytical results to the action levels and make appropriate disposal determinations. Soil samples are collected at the frequency of one ten-point composite sample for every 500 cubic yards (CY).

4.4.1 Analytical Parameters and Methods for Soil

The following analytical parameters and methods are utilized for soil sampling. The CM/RHM Manager or MT may modify this list for potentially impacted soil based on field screening observations.

- PAHs by EPA Method 8270C/D
- RCRA 8 metals by EPA Method 6010C/7471B/8011
- VOCs by EPA Method 8260B/8270C
- Asbestos by PLM

If concentrations in soil exceed the groundwater protection value (GPV) on the CDPHE Groundwater Protection Soil Cleanup table, indicating that the soil has the potential to impact water quality, individual compounds are further analyzed using Toxicity Characteristic Leachate Procedure (TCLP) methodology. Additionally, TCLP analysis is conducted for analytical parameters that do not have an associated GPV (e.g., metals).

4.4.2 Sampling of Potentially Impacted Groundwater

If during dewatering operations, after initial sampling has been completed, the MT identifies visual, olfactory, or PID readings indicating potential contamination, KMP will collect additional samples as needed from the frac tank where water

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is being pumped to. Based on these observations and additional sampling, the groundwater may be segregated for further analysis or alternate disposal options if warranted.

4.4.3 Analytical Parameters and Methods for Groundwater

The following parameters and methods are included for dewatering groundwater analysis. This list will be updated upon KMP's determination to utilize disposal or treatment (in accordance with the requirements of the receiving disposal site or the dewatering permit). The CM/RHM Manager or MT may select additional analytical parameters based on field screening observations.

- Total RCRA metals by EPA Method 6010C/6020A/7196A
- VOCs by EPA Method 8260B/8270C.
- SVOCs by EPA Method 8260B/8270C/8270D.
- TSS by EPA Method 2540D.
- TS by EPA Method 1684
- pH by EPA Method 9040C
- TPH by EPA Method 8015
- PCBs by EPA Method 8082

Individual analytical parameters may be further analyzed by TCLP, if required by the receiving solidification basin.

4.5 Comparison to Action Levels

The soil comparison criteria listed in Section 2.2.1 are compared to analytical results to classify soil RHMs as described below.

4.5.1 Soil Comparison Criteria

4.5.1.1 Soil and solid waste (e.g. buried waste material) requiring off-site disposal

If solid waste, such as historical landfill waste, is encountered during excavation, KMP will further characterize (if additional characterization is needed to supplement the initial soil sampling) and dispose of the material at DADS. All excavated soil is direct loaded into haul trucks and disposed of at DADS.

The CM/RHM Manager or MT completes all necessary waste profiling activities for materials that require off-site disposal. The Environmental Manager maintains waste manifests and/or bills of lading. Copies of all manifests and/or bills of lading will be provided to City and County of Denver (CCD).

If required, KMP will obtain applicable Air Pollution Emission Notices (APENs) from the CDPHE Air Pollution Control Division (APCD). The CM/RHM Manager includes documentation of applicable APEN compliance.

4.5.1.2 Non-Impacted/Unrestricted Reuse

Asphalt, concrete, and road base without indication of contamination from field screening can be recycled. If the material does not meet these criteria, then the material will be disposed of at DADS.

Table 1 – Pre-Approved Beneficial Use Materials

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Material	Beneficial Use
Reclaimed Asphalt	Road Base Component of hot or cold mix asphalt Re-compacted asphalt Roadside dressing Chip seal material Culvert cover Base stabilization Structural fill
Reclaimed Concrete, Brick, and Stone (non-asbestos bearing materials)	Road Base Concrete Aggregate Component of engineered structural fill Aggregate substitute Engineered rip rap Roadside dressing

4.5.1.4 Hazardous Waste

Excavated soil that exceeds maximum concentration of contaminants for the toxicity characteristic or cannot otherwise be accepted by a Subtitle-D landfill is containerized and disposed off-site at a facility permitted to receive hazardous waste in accordance with local, state, and federal requirements and approved by CDOT. If hazardous waste is encountered, KMP anticipates disposal at CSI as discussed in section 2.4.

If sample analysis indicates that the soil is designated as hazardous waste, within 72 hours of receipt of TCLP results, the soil is containerized in a lined container of appropriate size, labeled, and transported for disposal at a hazardous waste disposal facility appropriately licensed in accordance with local, state, and federal regulations.

Hazardous waste profiles and manifests must be signed by a representative authorized by CDOT. All hazardous waste manifests must list the CDOT as the generator. KMP is the arranger. KMP utilizes CDOT-approved hazardous waste vendors.

4.5.2 Comparison to Groundwater Disposal Criteria

The dewatering groundwater (and comingled stormwater) action levels listed in Section 2.2.2 are compared to analytical results to classify dewatering groundwater RHMs as described below.

4.5.2.1 Off-Site Disposal

Off-site waste disposal of such RHMs are disposed of at a facility appropriately licensed in accordance with local, state, and federal regulations and approved by CDOT. The CM/RHM Manager or MT completes all necessary waste profiling activities for off-site disposal. Additionally, the CM/RHM Manager maintains all necessary waste manifests and/or bills of lading. Copies of all manifests and/or bills of lading shall be provided to CCD.

4.5.2.2 Hazardous Waste

If groundwater analytical results exceed maximum concentration of contaminants for the toxicity characteristic, indicating that dewatering groundwater may be designated as hazardous waste, KMP conducts waste characterization sampling and compares results to maximum concentration of contaminants for the toxicity characteristic. If the waste characterization sampling maximum concentration of contaminants for the toxicity characteristic is exceeded, within 72 hours of receipt of

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TCLP results, the containerized dewatering groundwater is labeled and transported to a hazardous waste disposal facility appropriately licensed in accordance with local, state, and federal regulations.

If the waste characterization sampling results are below maximum concentration of contaminants for the toxicity characteristic, the containerized groundwater and comingled stormwater is managed as for off-site disposal in Section 4.5.2.1.

The CM/RHM Manager or MT completes waste profiling activities for materials that require off-site disposal. Additionally, the Environmental Manager maintains waste manifests and/or bills of lading. Hazardous waste profiles and manifests must be signed by a representative authorized by CDOT. All hazardous waste manifests must list CDOT as the generator. KMP is the arranger. Transportation and manifesting of hazardous waste transported on public highways, streets, or roadways is conducted in accordance with federal and state requirements.

4.6 Quality Control Requirements

Several different types of QC checks will be used to document the validity of the generated data. These QC checks reveal information about sampling technique, analyst technique, instrument capability, possible sources of contamination, precision of the results, and difficulties with the matrix.

All analyses will be performed by a laboratory that has a written QA/QC program that meets State and Federal EPA quality requirements and has been approved by the State of Colorado. Please refer directly to the SAP for specific requirements.

5.0 IMPORT FILL REQUIREMENTS

Import fill used for backfilling the OU2 sanitary line work must meet Project and DDPHE specifications. Import fill may originate from nearby City or CDOT projects with soil available for reuse. KMP must obtain CDOT and Denver Department of Public Health and Environment (DDPHE) approval prior to bringing imported fill onsite. KMP must test the material at a minimum frequency of one sample for every 500 cubic yards, as described in the SAP, from each source area for the following constituents:

- VOCs (EPA Method 8260b)
- SVOCs (EPA Method 8270)
- Total Petroleum Hydrocarbons (TPHs) (EPA Method 8015)
- RCRA 8 metals (EPA Method 6010 and 7471)
- Pesticides (EPA Method 8081)
- Herbicides
- Polychlorinated Biphenyls (PCBs) (EPA Method 8082)
- Asbestos (PLM)

The results shall be provided to DDPHE and CDOT for review and approval prior to use onsite.

6.0 PROJECT DOCUMENTATION

ED_002842A_00000589-00052

RHMs encountered during OU2 are tracked from identification through final disposal. The MTs complete daily site forms to document the origination location of an RHM, any field screening factors, and disposition information. These daily monitoring logs are supplemented by the field diaries maintained by the MTs, and all this documentation is included in the Monthly Statement of RHMs (Appendix D).

Documentation of the location within the OU2 area that the RHM occurs (soil, groundwater, etc.) is provided in the daily site forms and diaries. The CM/RHM Manager maintains all waste stream profiles, manifests, sampling results, and other characterizing documents for each RHM. This information is all packaged in the Monthly Statement of RHMs for the month that it is encountered.

These reports are submitted to CDOT for acceptance 10 working days after the end of each month during which RHMs were handled. These reports are available to the City and County of Denver through Aconex. After acceptance by CDOT, KMP submits the Monthly Statement of RHMs to the CDPHE. For work occurring in OU2 that is reported in a Monthly Statement of RHMs, that month's report will also be provided to EPA.

7.0 PLAN AMENDMENTS

This MMP for OU2 may be amended as needed with KMP, CDOT, and DDPHE approval. Amendments to this MMP for OU2 are documented, dated, and appended to this MMP for OU2. The modified MMP for OU2 is be transmitted in Aconex as well as kept with the Project records located in the onsite Project office.

8.0 DELIVERABLE CERTIFICATION

As per Schedule 8, Section 6.7.3 Document and Data Approval, I Megan Wood as the originator of this deliverable certify this deliverable to be complete and meets the requirements of the Project Agreement.

Megan Wood		4/29/2019
Printed Name of Originator	Signature of Originator	Date

9.0 REFERENCES

CDPHE Solid Waste and Guidance Policy https://www.colorado.gov/pacific/sites/default/files/HM_SW3_materials-management-plan.pdf

Beneficial Reuse and Materials Management Plan. CDOT Central 70 Project. September 12, 2017. Schedule 17, Environmental Requirements. Central 70 Project Agreement.

Health and Safety Plan, Central 70 Project. Kiewit Meridian Partners.

CDOT's Regulated Asbestos-Contaminated Soil Management Standard Operating Procedure, October 18, 2016

Limited Subsurface and Groundwater Investigation Report, CDOT Central 70 Project, Pinyon Environmental, January 17, 2017

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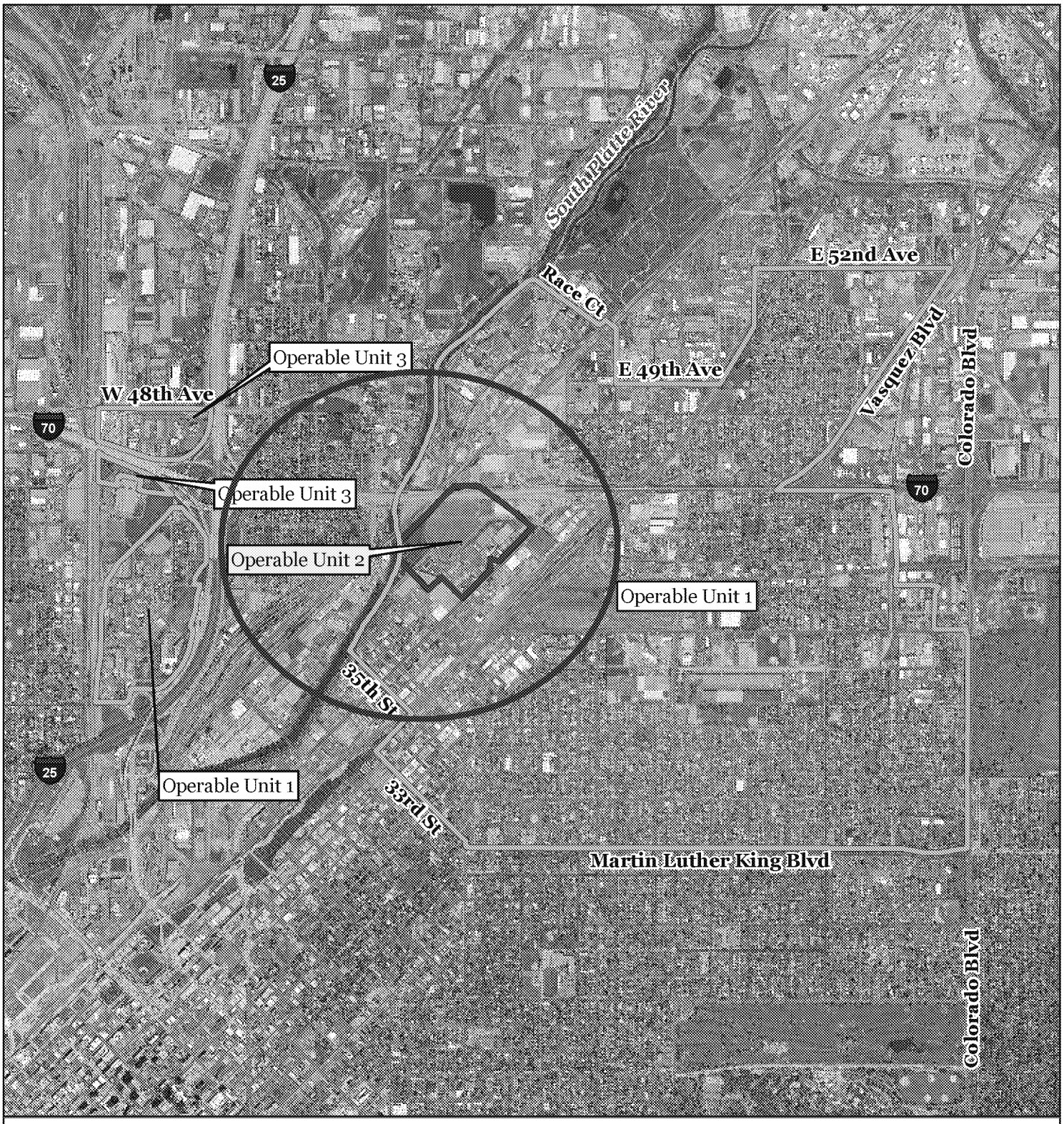
Appendix A

OU2 Area Map



Vasquez Blvd. and I-70

Operable Units

Denver County, Colorado

* 1 7 6 9 4 9 2 *

1769492

NPL Boundary

Operable Unit Boundary

*ICs do not exist for this site.

Map Date: January 14, 2011

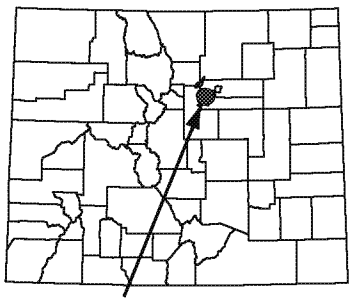
Map Projection: UTM, Meters, 13 North, NAD83

Data Sources: *Boundaries* - U.S. EPA Region 8 (2011); *Imagery* - USDA NAIP 1-meter aerial photo (2009).

0 1,000 2,000 Feet

N 0 250 500 Meters

Colorado

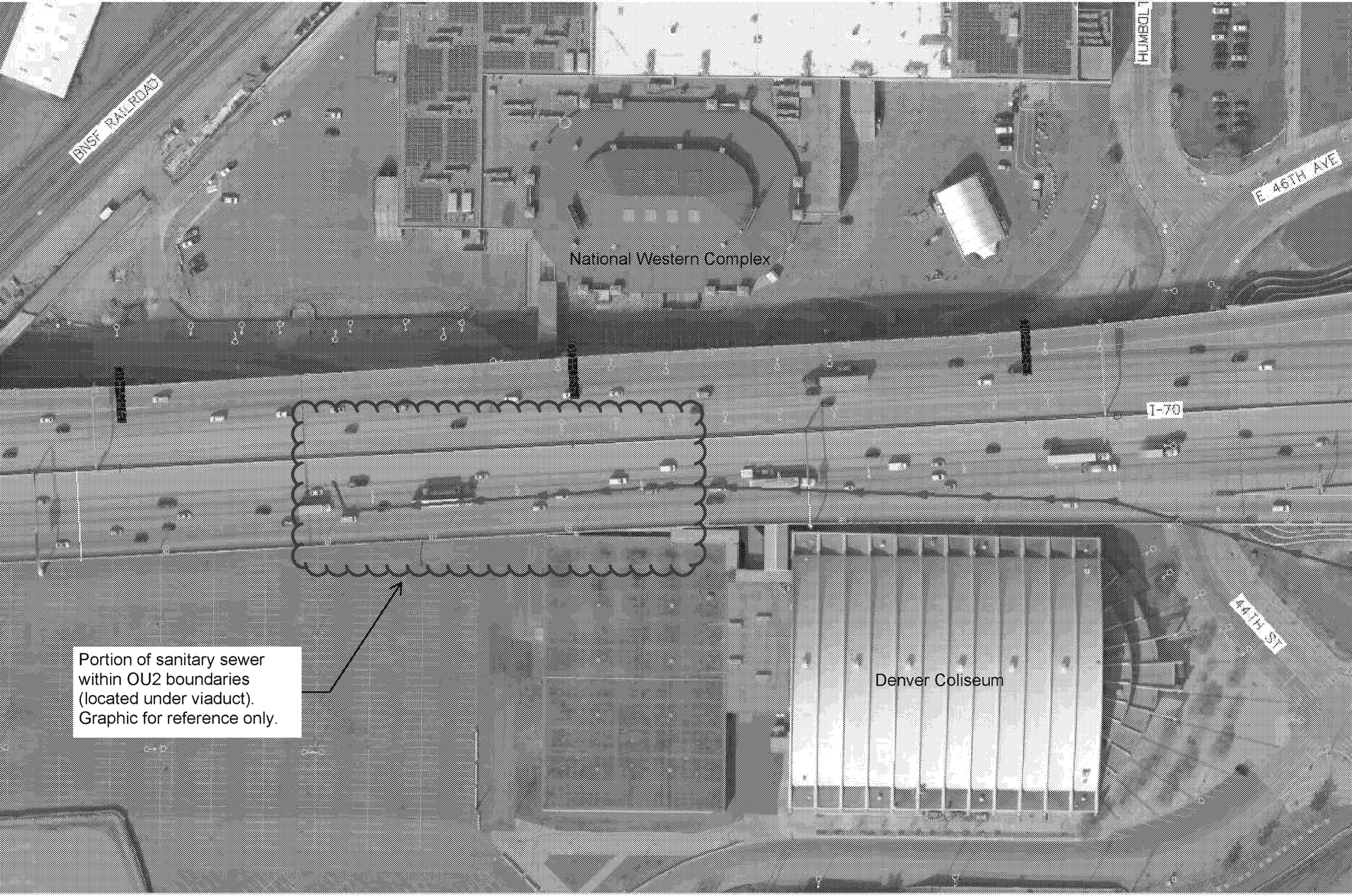


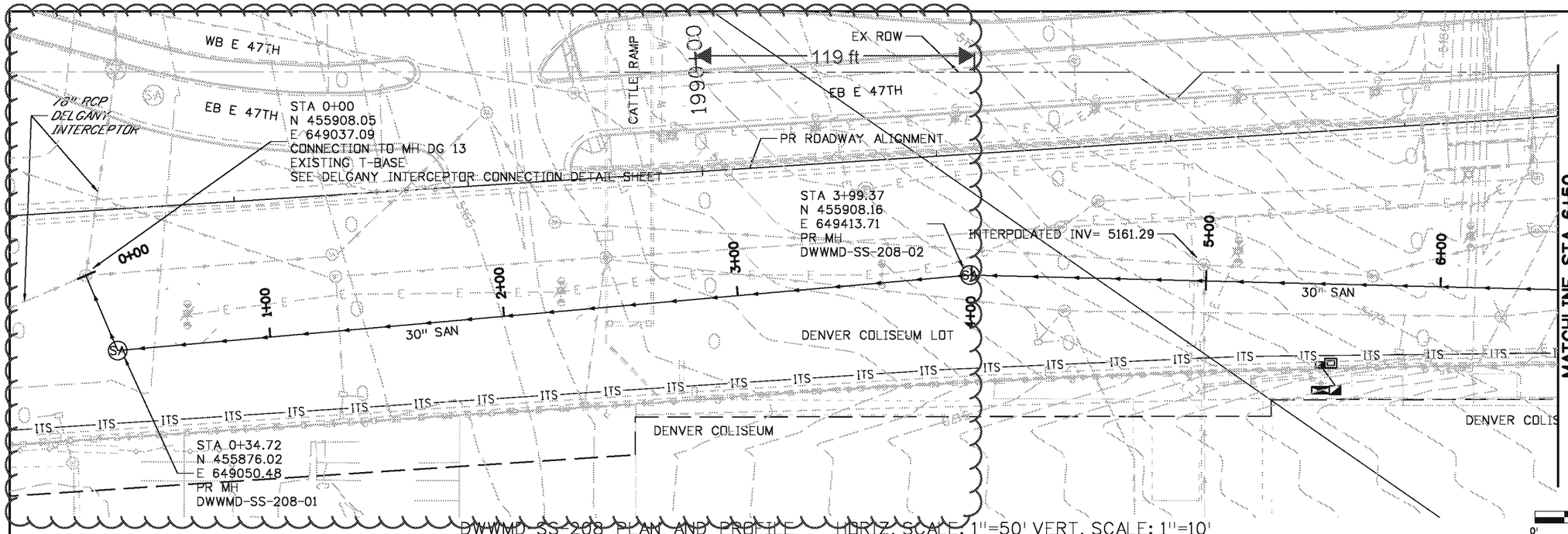
Area Enlarged

*Boundaries are based on the nature and extent of contamination and are subject to change.

Appendix B

OU2 Drawings


BNSF RAILROAD
National Western Complex
E 46TH AVE
I-70
44TH ST
Denver Coliseum
Portion of sanitary sewer within OU2 boundaries (located under viaduct). Graphic for reference only.

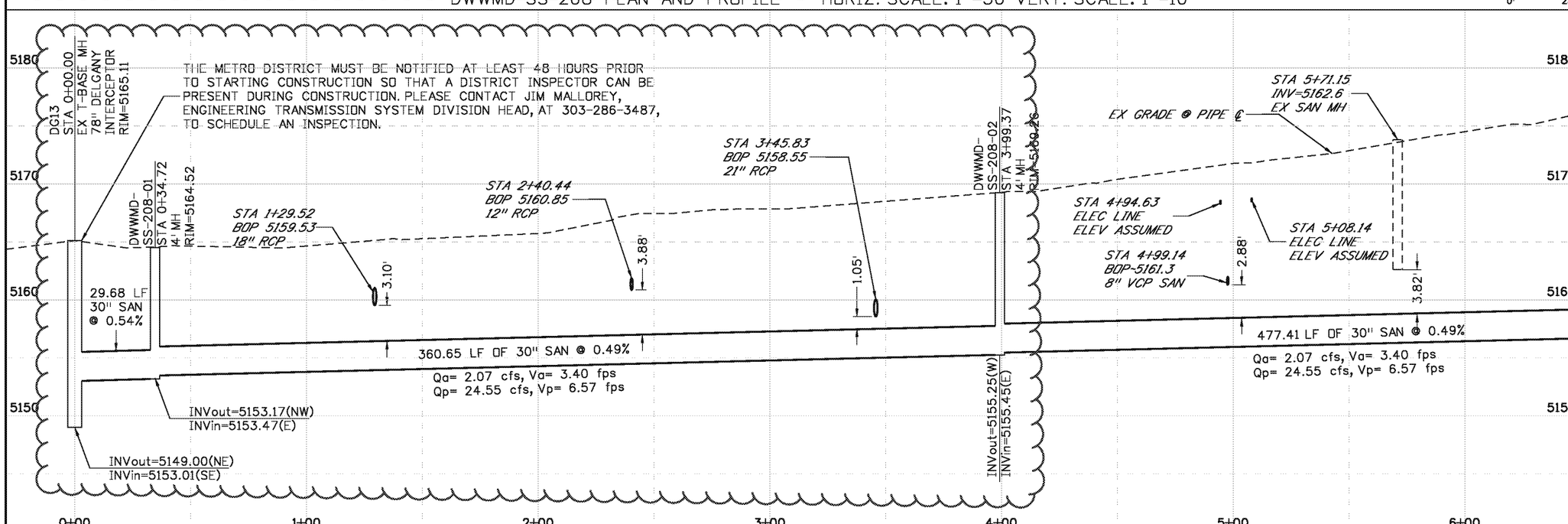


DWWMD-SS-208 PLAN AND PROFILE HORIZ. SCALE: 1"=50' VERT. SCALE: 1"=10'

0' 25' 50' 100'

NOTES:

1. ELEC, GAS, WATER, FIBER OPTIC, TELEPHONE AND OTHER DRY UTILITIES ARE AT ASSUMED ELEVATIONS UNLESS NOTED OTHERWISE
2. LABELS FOR EXISTING FEATURES ARE DISPLAYED IN ITALICS
3. SEE ABANDONMENT SHEETS FOR ABANDONMENT DETAILS OF EXISTING SANITARY
4. PIPE LENGTHS SHOWN IN PROFILE ARE FROM EDGE TO EDGE



Know what's below. Call before you dig.

PRELIMINARY NOT FOR CONSTRUCTION

90% SANITARY

5/17/2018	Sheet Revisions	Colorado Department of Transportation	As Constructed
DWWMD-208_01.dgn	Date: / Comments / Init.	2000 South Holly Street, Denver, CO 80222, Phone: 303-512-4272 FAX: 303-757-9866	No Revisions:
Kiewit meridiam PARTNERS		Region 1 KJS	Revised:
			Void:

CENTRAL 70 DWWMD-SS-208 STA 0+00-6+50		Project No./Code
Designer: KB	Structure Numbers	FBR 0704-234
Detailer: KB		19631
Subset: SANITARY 05	Subset Sheets: 3 of 10	Sheet Number SN50.100

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Appendix C

Target Analyte Comparison Criteria

PARAMETER	WASTE CODE	TOTAL* (mg/kg)	TCLP (mg/L)	Media
Metals				
Arsenic	D004	100	<5.05	Water/Soil
Barium	D005	2000	<100.0	Water/Soil
Cadmium	D006	20	<1.0	Water/Soil
Chromium	D007	100	<5.0	Water/Soil
Lead	D008	100	<5.0	Water/Soil
Mercury	D009	4	<0.2	Water/Soil
Selenium	D010	20	<1.0	Water/Soil
Silver	D011	100	<5.0	Water/Soil
VOCs				
Benzene	D018	10	<0.5	Water/Soil
Carbon tetrachloride	D019	10	<0.5	Water/Soil
Chlorobenzene	D021	2000	<100.0	Water/Soil
Chloroform	D022	120	<6.0	Water/Soil
1,1-Dichloroethane	D028	10	<0.5	Water/Soil
1,1-Dichloroethylene	D029	14	<0.7	Water/Soil
Methyl ethyl ketone (MEK)	D035	4000	<200.0	Water/Soil
Tetrachloroethylene	D039	14	<0.7	Water/Soil
Trichloroethylene	D040	10	<0.5	Water/Soil
Vinyl chloride	D043	4	<0.2	Water/Soil
SVOCs				
o-Cresol	D023	4000	<200.0	Water
m-Cresol	D024	4000	<200.0	Water
p-Cresol	D025	4000	<200.0	Water
Cresol, Total	D026	4000	<200.1	Water
1,4-Dichlorobenzene	D027	150	<7.5	Water
2,4-Dinitrotoluene	D030	2.6	<0.13	Water
Hexachlorobenzene	D032	2.6	<0.13	Water
Hexachlorobutadiene	D033	10	<0.5	Water
Hexachloroethane	D034	60	<3.0	Water
Nitrobenzene	D036	40	<2.0	Water
Pentachlorophenol	D037	2000	<100.0	Water
Pyridine	D038	100	<5.0	Water
2,4,5-Trichlorophenol	D041	8000	<400.0	Water
2,4,6-Trichlorophenol	D042	40	<2.0	Water
General				
pH	D002		2.0 < x < 12.5	Water
TS				Water
TSS				Water
Ignitability (liquids only)	D001		>140° F (60° C)	Water
PCBs			<50 mg/kg or ppm	Water
TPH				Water
Asebestos		ND		Soil

*If the TOTAL results are greater than 20 times the TCLP levels, than TCLP must be performed.

ND: Non-detect

Appendix D

Monthly Statement of Recognized Hazardous Materials Management Template

Kiewit meridiam PARTNERS

Monthly Statement of Recognized Hazardous Materials Management DATE

SUBMITTED TO:
Colorado Bridge Enterprise
High Performance Transportation Enterprise
c/o Colorado Department of Transportation

ED_002842A_00000589-00062

RECORD OF REVISIONS

Revision number	Date issued	Pages affected	Comments

ED_002842A_00000589-00063

DELIVERABLE CERTIFICATION

As per Schedule 8, Section 6.7.3 Document and Data Approval, I, Laura M. Tobin, as the originator of this deliverable certify this deliverable to be complete and meets the requirements of the Project Agreement.

_____	_____	_____
Printed Name of Originator	Signature of Originator	Date

ED_002842A_00000589-00064

TABLE OF CONTENTS

Record of Revisions 1
Deliverable Certification 2
Table of Contents 3
1. Summary of Recognized Hazardous Material Related Activities 4
2. RHM-Related Activities 4
2.1 General Construction 4
2.2 Site Structures Abatement and Demolition 4
2.3 Appendix B Parcels 4
2.4 Unidentified Suspect Materials and REleases 4
2.5 Waste Manifest Compliance 4
2.6 Century Link 4
2.7 Monitoring and Piezometer wells 4
ATTACHMENT 1: HSO Monthly Report 8
ATTACHMENT 2: Daily MT Logs 9
ATTACHMENT 3: MT Field Diary Notes 10
ATTACHMENT 4: Summary of Manifested Soil 11
ATTACHMENT 5: Non-Hazardous Waste Manifests 12
ATTACHMENT 6: RHM Tracking Log for Soils 13
ATTACHMENT 7: Map of RHM Soils 14
ATTACHMENT 8: Demolition Properties Waste Manifests 15
ATTACHMENT 9: Appendix B Parcel Supplements 16
ATTACHMENT 10: RHM Tracking Table (Other) 17
ATTACHMENT 11: RHM Tracking Map (Other) 18
ATTACHMENT 12: Monitoring Wells Placeholder 19
ATTACHMENT 13: Century Link Placeholder 20
ATTACHMENT 14: Other Waste Manifest Placeholder 21
ATTACHMENT 15: Placeholder 22

ED_002842A_00000589-00065

1. Summary of Recognized Hazardous Material Related Activities

2. RHM-Related Activities

2.1 GENERAL CONSTRUCTION

2.2 SITE STRUCTURES ABATEMENT AND DEMOLITION

2.3 APPENDIX B PARCELS

2.4 UNIDENTIFIED SUSPECT MATERIALS AND RELEASES

2.5 WASTE MANIFEST COMPLIANCE

2.6 CENTURY LINK

2.7 MONITORING AND PIEZOMETER WELLS

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ATTACHMENT 1: HSO Monthly Report

ED_002842A_00000589-00068

ATTACHMENT 2: Daily MT Logs

ED_002842A_00000589-00069

ATTACHMENT 3: MT Field Diary Notes

ED_002842A_00000589-00070

ATTACHMENT 4: Summary of Manifested Soil

ED_002842A_00000589-00071

ATTACHMENT 5: Non-Hazardous Waste Manifests

ED_002842A_00000589-00072

ATTACHMENT 6: RHM Tracking Log for Soils

ED_002842A_00000589-00073

ATTACHMENT 7: Map of RHM Soils

ED_002842A_00000589-00074

ATTACHMENT 8: Demolition Properties Waste Manifests

ATTACHMENT 9: Appendix B Parcel Supplements

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ATTACHMENT 10: RHM Tracking Table (Other)

ED_002842A_00000589-00077

ATTACHMENT 11: RHM Tracking Map (Other)

ATTACHMENT 12: Monitoring Wells Placeholder

ATTACHMENT 13: Century Link Placeholder

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ATTACHMENT 14: Other Waste Manifest Placeholder

ED_002842A_00000589-00081

ATTACHMENT 15: Placeholder

ED_002842A_00000589-00082

Appendix E

DDPHE Memo regarding work in the Vasquez Boulevard and I-70 Superfund site

MEMO

ENVIRONMENTAL QUALITY
DENVER PUBLIC HEALTH & ENVIRONMENT

To: Jenn Bradtmueller, Kiewit Infrastructure Co.

From: Andrew Ross, Denver Department of Public Health and Environment

Date: June 7, 2018

Re: Sanitary sewer relocate through Vasquez Boulevard and I-70 Superfund Site

---

This memo is intended to inform Kiewit Meridiam Partners (KMP) about the coordination needed to conduct earth disturbing activities in Operable Unit 2 (OU2) of the Vasquez Boulevard and I-70 Superfund Site. This coordination is outside of the Environmental Impact Statement reevaluation process. The agencies requiring coordination for KMP to conduct work in OU2 are the U.S. Environmental Protection Agency (EPA), the Colorado Department of Public Health and Environment (CDPHE), and the Denver Department of Public Health and Environment (DDPHE). Contact information for the agencies is below.

Jesse Aviles
U.S. Environmental Protection Agency, Mailcode: OEPR-SR
1595 Wynkoop Street
Denver, CO 80202-1129
303-312-6287
aviles.jesse@epa.gov

Fonda Apostolopoulos
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246
303-692-3411
Fonda.Apostolopoulos@State.co.us

Kara Edewaard
Denver Department of Public Health and Environment
200 W. 14th Ave., Suite 310
Denver, CO 80204
720-865-5432
kara.edewaard@denverorg.gov

DDPHE requests that KMP agree to the below items before initiating work in OU2. KMP should confer with EPA and CDPHE separately to determine their requirements to work in OU2.

1) **Work Plan**: KMP shall provide a memo describing the earth disturbing activities to be conducted in OU2 (see attached site map). The memo shall include a construction schedule, map and/or drawings of the sanitary sewer relocation, and contact information for the contractors that will perform the work.

2) **Management of Waste Material**: Construction of the sanitary sewer liner through OU2 will require excavation and handling of soil and solid waste material. Investigations have identified lead and arsenic in soils and subsurface soil as contaminants of concern for OU2. Additionally, municipal wastes were landfilled in this area and investigations have identified volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and potentially friable asbestos associated with those materials. Together, these contaminated soils and solid waste are the "waste material" that will need to be removed, if encountered. It is expected that concentrations of most contaminants of concern in the waste material will be sufficiently low such that most of the material may be managed as a RCRA non-hazardous solid waste. All RCRA non-hazardous material, including material containing friable asbestos, shall be disposed of at the Denver Arapahoe Disposal Site (DADS) under disposal certificates issued by landfill operator. Respondent will manage RCRA hazardous material as hazardous waste and will treat and/or dispose of such material at a RCRA-licensed Subtitle C treatment, storage, or disposal facility. Criteria and protocols for management and disposal of all material shall be incorporated into the Materials Management Plan.

3) **Management of Contaminated Groundwater**: Groundwater may be encountered during excavation of the sewer trench. Historic groundwater sampling has detected VOCs and metals above Colorado Basic Standards for Groundwater. As necessary, groundwater collected during construction dewatering will be treated prior to release to a receiving stream or transported offsite for treatment and disposal. Criteria and protocols for collection, treatment, and disposition of these liquids, as well as any other liquid that comes in contact with the waste material, including washout and decontamination liquids, shall be incorporated into the Materials Management Plan.

4) **Sampling and Analysis Plan**: KMP shall provide a sampling and analysis (SAP) associated with the earth disturbing activities. The SAP shall consist of two parts:
   - A Field Sampling Plan (FSP), which describes the number, type, and location of samples and the type of analyses; and
   - A Quality Assurance Project Plan (QAPP), which describes policy, organization, and functional activities and the data quality objectives and measures necessary to achieve adequate quality for use in planning and documenting all soil excavation activities. KMP shall use quality assurance, quality control, and other technical activities and chain of custody procedures for all samples consistent with "EPA Requirements for Quality Assurance Project Plans (QA/RS)" (EPA/240/B-01/003, March 2001, reissued May 2006), "Guidance for Quality Assurance Project Plans (QA/G-5)" (EPA/240/R- 02/009, December 2002).

5) **Materials Management Plan**: KMP shall submit a materials management plan (MMP) to DDPHE prior to excavation. The MMP shall describe:
   - Testing, management and disposal requirements for waste material;
   - Requirements for management and treatment of and groundwater captured during construction dewatering operations;
   - Management of liquids and solids from design investigations, groundwater sampling, and equipment decontamination. KMP should reference the Final Materials Management Plan, Globeville Landing Outfall Project (EMSI, Jan 2016) for required content. The MMP shall comply with all Colorado Department of Public Health and Environment (CDPHE) regulations, including regulations relating to asbestos.

6) **Waste Manifests**: All waste manifesting for soil or debris removed from OU2 is the responsibility of KMP.

7) **Health and Safety Plan**: KMP shall provide a project-specific Health and Safety Plan compliant with all Occupational Safety and Health Administration regulations to DDPHE prior to initiation of work.

8) **Data Sharing Agreement**: KMP shall provide a data sharing agreement for all records related to the environmental aspects of the project including, but not limited to, soil characterization data collected prior to or during earth disturbing activities in OU2.

9) **Completion Report**: KMP shall provide a project completion report. The completion report shall include a drawing of the as-built alignment of the sanitary sewer line through OU2, including GPS coordinates and elevations, a summary of the volume of waste materials removed by waste type, a waste manifest summary, and all field reports related to validation of the waste material.

10) **Existing Monitoring Wells**: KMP shall protect site monitoring wells during construction activities. See the attached site map and monitoring well coordinates. If a monitoring well is damaged, KMP shall be responsible for replacement of that monitoring well.

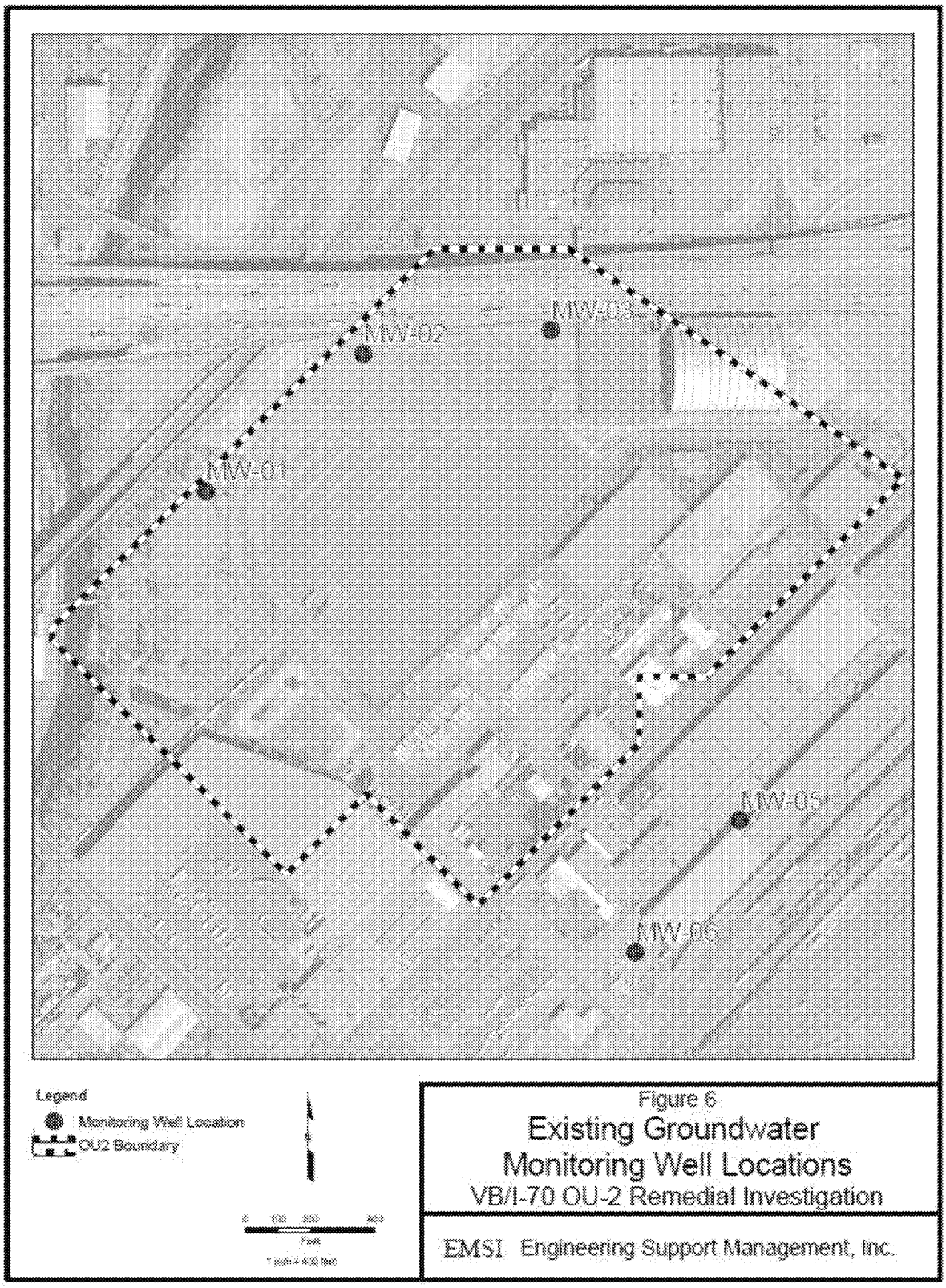
11) **Community Advisory Group**: The OU2 site has an EPA sponsored Community Advisory Group (CAG). KMP will need to confer with EPA to determine how and when the work in OU2 will be communicated to the CAG.

12) **Air Monitoring**: KMP will need to confer with EPA regarding air monitoring. EPA may require air monitoring for PM_{10}, arsenic and lead on a weekly basis. If required, a monthly summary report shall be provided to the agencies. DDPHE requests that KMP provide a fugitive dust plan for this work prior to initiating excavation.

13) **Project Access**: KMP shall provide access to the excavation site to appropriate DDPHE employees.

ED_002842A_00000589-00086

Vasquez Blvd / I-70 OU2 Site Map



Monitoring Well Locations – OU2

Date 18 Mar '11

SURVEY DATA REPORT

Project Monitor Wells at the Denver Coliseum, Denver, Colorado

Prepared for EMSI -- Tim Shangraw

Compiled by Ludeman

PID	Northing	Easting	Access Lid Elevation	PVC Elevation	Ground Elevation	Description
MW-1	1708732.35	3147158.77	5173.67	5173.50	5173.67	2" PVC in 8" Access Lid
MW-2	1709183.92	3147657.53	5162.02	5161.66	5162.02	2" PVC in 8" Access Lid
MW-3	1709228.21	3148228.30	5163.72	5163.34	5163.72	2" PVC in 8" Access Lid

Appendix F

Beneficial Reuse and Materials Management Plan, CDOT Central 70 Project, dated September 12, 2017 (Includes CDOT RACS SOP)

Central 70

Formerly the I-70 East Project

Rev September 12, 2017

Beneficial Reuse and Materials Management Plan

CDOT Central 70 Project
I-25 to Chambers Road
Denver, Colorado

Prepared For:

Colorado Department of Public Health and Environment
Materials Management Unit
4300 Cherry Creek Drive South
Denver, Colorado 80246

Prepared By:

Colorado Department of Transportation
2000 South Holly Street
Denver, Colorado 80222

Formerly the I-70 East Project

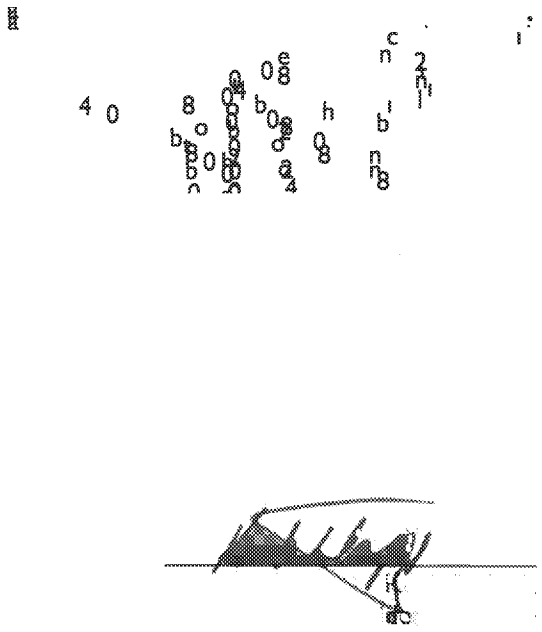


Table of Contents

1. Introduction 5
   1.1 Project Description 5
   1.2 Purpose of BRMMP 6
   1.3 Key Parties and Responsibilities 6
2. Background Information 9
   2.1 Existing Conditions 9
   2.2 Project Areas 10
   2.3 Soil Evaluation Values 10
   2.4 Vertical Horizons 10
3. Soil Evaluation 12
   3.1 Field Screening 12
   3.2 Sampling Analysis Protocol 13
      3.2.1 Confirmation Sampling Frequency 13
      3.2.2 Sampling and Analytical Parameters 14
      3.2.3 Waste Characterization 15
         3.2.3.1 The 20-Times Rule 15
4. Material Handling Procedure 16
   4.1 Predetermined Action Levels 16
      4.1.1 Non-Impacted/Unrestricted Reuse 16
      4.1.2 Impacted/Restricted Reuse 17
      4.1.3 Health Risk/Disposal 17
      4.1.4 Hazardous Waste 17
   4.2 Soil Segregation Procedures 17
5. Reporting 19
6. Post-Construction Material Handling Procedure 20
7. References 21

Table of Contents (continued)

Figures

Figure 1 Site Location

Figure 2 Project Overview

Appendices

Appendix A CDOT Regulated Asbestos-Contaminated Soil Management Standard Operating Procedure

Appendix B USEPA Toxicity Characteristic Maximum Concentration of Contaminants

Appendix C USEPA Regional Screening Levels

Appendix D Sites of Concern

Appendix E CDPHE GIS Mapping Requirements for Environmental Covenants

Acronyms

ACM	Asbestos Containing Material
APEN	Air Pollution Emission Notice
APCD	Air Pollution Control Division
BMP	Best Management Practices
BRMMP	Beneficial Reuse and Materials Management Plan
CABI	Certified Asbestos Building Inspector
CCR	Colorado Code of Regulations
CDPHE	Colorado Department of Health and Environment
CDOT	Colorado Department of Transportation
CFR	Code of Federal Regulations
CM	Compliance Manager
COC	Contaminants of Concern
EC	Environmental Covenant
ESA	Environmental Site Assessment
DRO	Diesel Range Organics
GIS	Geographic Information Systems
GPS	Global Positioning System
GPV	Groundwater Protection Value
GRO	Gasoline Range Organics
GWS	Colorado Basic Standards for Groundwater
HAZWOPER	Hazardous Waste Operations and Emergency Response
I-25	Interstate 25
I-70	Interstate 70
mg/kg	Milligram Per Kilogram
MT	Monitoring Technician
NEUR	Notice of Environmental Use Restriction
OPS	Colorado Department of Labor, Division of Oil and Public Safety
ORO	Oil Range Organics
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbons
PAL	Predetermined Action Levels
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethylene
PID	Photo-ionization Detector
PPM	Parts Per Million
QPM	Qualified Project Monitor
RACS	Regulated Asbestos Containing Soil
RBSL	Risk-Based Screening Level
RCRA	Resource Conservation Recovery Act
RCRA 8	Eight Resource Conservation Recovery Act Metals
RSL	Regional Screening Level
RSL-I	Regional Screening Level – Industrial
RSL-R	Regional Screening Level – Residential
SPLP	Synthetic Precipitation Leach Procedure
SVOC	Semi-Volatile Organic Compounds

TAL	Target Analyte List
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
VB/I70	Vazquez Boulevard/Interstate 70 Superfund Site
VOC	Volatile Organic Compounds

1. Introduction

This Beneficial Reuse and Materials Management Plan (BRMMP) has been prepared by the Colorado Department of Transportation (CDOT) for the Central 70 Project between Interstate 25 (I-25) and Chambers Road in Denver, Colorado (Figure 1; Project). The BRMMP has been prepared in general conformance with Section 8.6 of the Regulations Pertaining to Solid Waste Sites and Facilities, 6 Colorado Code of Regulations (CCR) 1007-2, pertaining to beneficial use. The BRMMP defines material reuse criteria, screening and sampling protocols, and documentation requirements that will be utilized during soil disturbing activities (e.g., excavation) within the limits of the Project during construction. Following substantial completion of the Project, CDOT plans to establish an Environmental Covenant (EC) or a Notice of Environmental Use Restriction (NEUR), which will provide use restrictions for the Project, the purpose of which is to limit potential exposure scenarios to site workers and incidental non-worker contact. The EC will be limited to those locations on CDOT property within the Project area where soil not meeting the unrestricted reuse criteria (Section 4) are deposited. The EC will meet the requirements of Colo. Rev. Stat. §§ 25-15-317 to -325. This BRMMP will be incorporated into the EC by reference.

This BRMMP has been designed for implementation by CDOT and any contractors ("Contractors") performing work within the Project area covered by the EC. Following substantial completion of the Project, this BRMMP will be provided to the holders of record of any leases, licenses, rights-of-way, easements or other instruments granting a right to use the Property ("Holders") within the Project area. Further, to the extent feasible, CDOT will assist the Holders in complying with this BRMMP, as well as recommend Best Management Practices (BMPs) for implementation of the BRMMP. CDOT will work together with Contractors and Holders to ensure compliance with the BRMMP. Failure to comply with this BRMMP may result in non-compliance and enforcement action from CDPHE.

1.1 Project Description

The Project consists of the following improvements (Figure 2):

- Restriping Interstate 70 (I-70) from I-25 to Brighton Boulevard to accommodate one Tolled Express Lane in each direction;
- Complete reconstruction of I-70, from Brighton Boulevard to Sand Creek, including the addition of one Tolled Express Lane in each direction;
- Removal of the 50-year-old viaduct and lowering the interstate between Brighton and Colorado Boulevards;
- Construction of a new 4-acre cover over the interstate between Clayton and Columbine Streets; and
- Widening I-70 from Sand Creek to Chambers Road to accommodate one Tolled Express Lane in each direction.

As a result of the lowered section, Project activities west of Colorado Boulevard will result in substantial cutting and excavation of material. Whereas, reconstruction activities east of Colorado Boulevard will require filling activities to obtain the desired grade. However, overall it is anticipated that the Project activities will result in an overall net "cut" or removal of material from the Project area.

1.2 Purpose of BRMMP

The purpose of this BRMMP is to define reuse criteria for the Project thereby streamlining material management, reducing construction delays, and minimizing off-site disposal of low-risk media. When implemented properly, this BRMMP will provide the means and methods to ensure that work activities are completed in such a way as to minimize worker exposure to potentially impacted soil, prevent releases to the environment, and ensure proper management or disposal of contaminated materials. Further, this BRMMP has been prepared to minimize potential delays, and to develop approved standard procedures that will be implemented as needed in the event that potentially impacted soil is encountered during soil disturbing activities. The BRMMP also establishes procedures for post-project handling of impacted soil.

It is the responsibility of Project personnel to adhere to the BRMMP, follow all applicable regulations, obtain the proper permits, and have qualified field personnel to identify potentially impacted soil. Wastes will be managed according to one of the following categories:

1. Hazardous waste, as defined under the Resource Conservation and Recovery Act (RCRA), requiring off-site disposal and/or off-site treatment at CDPHE-approved sites
2. Contaminated soils requiring off-site disposal
3. Soils to be stockpiled for further characterization
4. Soils with concentrations of constituents of concern below the applicable values, that can be reused within the Project boundary in accordance with Section 4
5. Soil with concentrations of constituents of concern below the United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for residential use (RSL-R) that can be reused within the Project area or off-site without restriction
6. Waste material to be contained for further characterization
7. Regulated Asbestos-Contaminated Soil (RACS) will be managed in accordance with CDOTs Regulated Asbestos-Contaminated Soil Management Standard Operating Procedure (October 18, 2016), which has been approved by CDPHE (Appendix A)

1.3 Key Parties and Responsibilities

It will be the responsibility of CDOT, Contractors, and Holders, conducting soil disturbing activities within the Project area, to provide personnel qualified to follow and implement this BRMMP, including, but not limited to material sampling, selection of analytical parameters, data evaluation, and decisions regarding final disposition of displaced material. At a minimum, all parties working in the Project area will designate a BRMMP Compliance Manager (CM) who meets at least one of the following criteria:

- Hold a current certification/license as a Professional Geologist issued by a state licensing body, the American Institute of Professional Geologists, or the National Association of State Boards of Geology;
- Hold a current certification/license as a Professional Engineer issued by the State of Colorado or a reciprocal state licensing agency;
- Hold a current certification as an Environmental Professional issued by the Academy of Board Certified Environmental Professionals; or

- Hold a current designation as a Registered Environmental Professional by the Colorado Department of Labor and Employment, Division of Oil and Public Safety.

Additionally, the CM must have the following qualifications:

- Completed the Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and current eight-hour annual refresher;
- Completed the OSHA eight-hour Supervisory training; and
- Be a Qualified Project Monitor (QPM) as defined by Section 5.5.3 of 6 CCR 1007-2, Part 1, or have completed two-hour asbestos in soil awareness training and have direct access to a QPM.

The CM will be responsible for ensuring:

- Delineation of vertical horizons as described in Section 2.4;
- Field screening of soils is completed in adherence with Section 3.1;
- All necessary samples are collected to characterize potential contaminants of concern (COC) as described in Section 3.2;
- Daily logs are maintained, when onsite, thoroughly detailing site activities;
- Cradle-to-grave tracking disposition of the seven types of soil listed in Section 1.2; and
- Adherence to this BRMMP through documentation as described in Section 5.

The CM may delegate the responsibilities noted above to Monitoring Technicians (MTs) who have the following minimum qualifications:

- A bachelor's degree from an accredited institution in geology, engineering, environmental science, or another related field;
- Completed the OSHA 40-hour HAZWOPER training and current eight-hour annual refresher;
- Be a State and EPA-Colorado Asbestos Building Inspector (CABI) and meet the criteria of a QPM; and
- Be properly trained in standard methods for soil screening, sample collection, and sample handling.

The CM and MTs will be responsible for the evaluation and monitoring of materials during soil disturbing activities within the Project area. One CM or MT will be utilized at each soil disturbing face such that all excavated material can be screened in accordance with this BRMMP. Within the Central 70-East Project Area, a CM or MT is not required to be onsite at each soil disturbing face if the CM determines no impacted materials will likely be encountered; if impacted materials are encountered during construction, work shall stop until a CM or MT is onsite to complete the screening and sampling required in Sections 3.1 and 3.2. While the CM may delegate responsibilities to MTs, the CM will retain responsibility for adherence to this BRMMP. As referenced throughout the remainder of this BRMMP, "CM" refers to the CM and/or the CM's delegate (MT).

2. Background Information

2.1 Existing Conditions

The Project area is surrounded by residential, commercial and industrial site uses. Numerous environmental investigations have been completed within and surrounding the Central I-70 corridor, including Phase I Environmental Site Assessments (ESAs) and limited subsurface investigations, in order to evaluate the location, extent and magnitude of COCs that may be encountered during Project activities. In general, the following standards and cleanup thresholds were used during previous investigations:

- USEPA Toxicity Characteristic Maximum Concentration of Contaminants (Appendix B).
- USEPA RSLs for soil. It should be noted that the most current values were published in June 2017 (USEPA, 2017); however, The above-referenced reports may have used previous versions or other regulatory values (e.g., the Colorado Soil Evaluation Values, which are no longer applicable). The RSLs are health-based values for various chemicals (or analytes), and are based on specific exposures and/or scenarios. These levels assign numerical contaminant concentrations as preliminary cleanup goals.
- OPS Risk-Based Screening Levels (RBSLs) including the threshold of 500 milligrams per kilogram (mg/kg) for Total Petroleum Hydrocarbons (TPH) in soil.

The following is a summary of environmental conditions in the Project area, based on a review of available documents and information obtained during previous soil and groundwater investigations (Pinyon, 2016):

- Polycyclic aromatic hydrocarbons (PAHs), including benzo(a)pyrene, were detected in soil samples at concentrations exceeding the regulatory standards in multiple soil samples collected from Project area.
- Arsenic in soil was detected at concentrations exceeding the regulatory values for residential land use throughout all project areas; however, the concentrations were generally below the CDPHE background value for naturally occurring arsenic in Colorado (CDPHE, 2014a).
- Lead was detected in soil throughout the Project area that exceeded regulatory values.
- Gasoline range organics (GRO), diesel range organics (DRO), and oil range organics (ORO) have been documented in the soils in the Project area.
- Cadmium, arsenic, manganese, iron, chloroform, tetrachloroethylene (PCE), trichloroethylene (TCE), and hexavalent chromium were detected above the groundwater standards in the Project area.
- Groundwater samples throughout the Project area indicated potential dewatering permit exceedances of total, potential and dissolved metals, as well as some volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Sampling also indicated pH levels outside of the range allowed by typical dewatering permits.

2.2 Project Areas

The Project area will be subdivided into two main areas, defined by the predominant current land use and planned construction activities, as follows:

- Central 70 – West: Bound to the east by Colorado Boulevard and to the west by I-25, predominantly heavy industrial areas with a moderate to high potential for Project activities to encounter contaminated soil and/or groundwater. The majority of construction activities in this area will involve excavation or a net cut of soil rather than emplacement (e.g., net cut).
- Central 70 – East: Bound to the east by Chambers Road and to the west by Colorado Boulevard. Predominantly light to heavy industrial areas with a low to moderate potential for Project activities to encounter contaminated soil and/or groundwater resulting from historical and current uses. The majority of construction activities in this area will involve emplacement or a net fill of soil rather than excavation.

2.3 Soil Evaluation Values

The EC restricts or will restrict in the future any development of the area defined in the EC to industrial or commercial uses, which limits potential exposure of impacted material to roadway and utility workers only. The EC also triggers procedures for post-project handling of impacted soil established in Section 6.

With the exception of arsenic, decisions regarding reuse of excavated material from the Project area will be based on the USEPA RSL for Residential and Industrial landuse (RSL-R and RSL-I respectively) (USEPA, 2017) (Appendix C). Arsenic reuse values have been derived from the remediation values presented in the Vazquez Boulevard/Interstate 70 Superfund site (VB/I70) standard. The non-impacted/unrestricted reuse value for arsenic has been set at 11 milligrams per kilogram (mg/kg), while the impacted/restricted reuse value has been set at 35 mg/kg.

For the purpose of this BRMMP and for beneficial use of material displaced during construction of the project, predetermined action levels (PALs) have been developed and are further discussed in Section 4.

2.4 Vertical Horizons

The Project area has been a roadway since approximately 1964, suggesting that the potential for releases of hazardous substances or petroleum products that may have impacted soil and/or groundwater is generally limited to sources outside of the Project area. Given the planned depth of construction and anticipated volume of soil to be displaced, the following vertical horizons have been developed to facilitate materials management during construction:

- Asphalt and Concrete Surfacing – Generally limited to existing roadways and parking lots
- Road Base – Engineered fill material placed specifically for the purpose of establishing a stable base layer beneath asphalt and concrete surfacing
- Near Surface Soil – From ground surface or immediately beneath existing road base to a depth of one foot below the road base interface or existing grade in areas where no asphalt or concrete is present.

- Shallow Unsaturated Soil – From the base of the Near Surface Soil interval to a depth of five feet below existing ground surface or the native soil interface, whichever is greater.
- Unsaturated Native Soil – From the bottom of the Shallow Unsaturated Soil interval to the groundwater interface.
- Saturated Soil – All soil below the groundwater interface.

Material handling procedures for each of these vertical horizons are discussed further in Section 4.

3. Soil Evaluation

3.1 Field Screening

The CM will be responsible for evaluating disturbed material throughout the Project area, taking into consideration historical site uses and potential sources of impacts. The most prevalent contaminants within the Project are PAHs and the RCRA 8 metals. In general, these contaminants cannot be easily screened using field instrumentation. Therefore, field screening will follow visual and olfactory indicators for contamination (i.e., "looks bad, smells bad" parameters), as outlined below, in addition to standard use of a photoionization detector (PID), using the headspace technique, with confirmation through analytical testing (Section 3.2).

Field screening will, at a minimum, include the following "looks bad, smells bad" parameters:

- Visual staining, including greying (gray material, indicating reducing subsurface conditions), or dark coloration;
- Presence of non-soil materials (e.g., debris, sludge, powders, coal-based fill);
- Presence of distinguishable odor; and/or,
- Discrete layers in soil cross section that generally appear out of place.

Handling and transportation of screened material which may be potentially impacted will be minimized, to the extent feasible, until a reuse determination can be made. However, when handling is required, the following precautions will be used:

- Whenever possible, handling will be completed by mechanical means, including the use of mechanized excavation equipment;
- All potentially impacted soil will be placed on 6-millimeter plastic sheeting until additional assessment has been completed by the CM;
- Soil stockpiles of potentially contaminated soil or other materials will be limited in volume to what can be reasonably managed, within 90 days, by CDOT, Contractors, or Holders;
- Stormwater BMPs will be installed around stockpiles of potentially contaminated material to prevent water runoff;
- Stockpiles will be evaluated for potential windblown impact and mitigated, in accordance with local, state, and federal requirements;
- Stockpile areas will be clearly delineated to prevent contact with unauthorized personnel;
- Suspicious materials will be further evaluated by the CM in accordance with Section 4 of this BRMMP;
- When additional assessment of this material indicates that the material exceeds applicable regulatory requirements, the CM will coordinate with the Contractor to coordinate beneficial reuse or proper off-site disposal of the material (Section 3.2.3); and,

- Any contaminated soils that are generated will be managed in accordance with applicable local, state and federal regulations, including, but not limited to, obtaining the applicable Air Pollution Emission Notice (APEN) from the CDPHE Air Pollution Control Division (APCD). The CM shall include documentation of APEN compliance in the BRMMP records.

The CM will complete all necessary waste profiling activities for materials that will require off-site disposal at an approved disposal site, based on laboratory analytical results. Additionally, the CM will maintain all necessary waste manifests. Waste profiles and manifests must be signed by a representative authorized by CDOT.

3.2 Sampling Analysis Protocol

When potentially contaminated soil is encountered, as identified through field screening and/or location-specific data from previous investigations (Appendix D), the CM will be responsible for sampling, preparation of waste profiles, and applicable notifications. The CM will be responsible for evaluating potentially contaminated materials (for disposal purposes) in accordance with Colorado Hazardous Waste Regulations (6 CCR 1007-3), and in accordance with all other applicable federal, state and local regulations Information regarding the reuse or disposal of contaminated media are presented in Sections 2.3 and 4.1.

3.2.1 Confirmation Sampling Frequency

In the absence of any visual or olfactory indication that contamination may be present in excavated soil, in general, the collection of confirmation samples (Section 3.2) will be based on vertical horizons in the Project area as follows for a continuous excavation:

- Asphalt, Concrete, and Road Base – These materials may be recycled and reused in accordance with CDOT standard specifications and the current CDPHE Beneficial Use criteria (CDPHE, 2016a).

- Near Surface Soil – West of Colorado Boulevard, soil from existing ground surface to a total depth of one foot will be excavated, characterized, and transported for off-site disposal at a CDPHE-approved landfill facility. Waste characterization samples will be collected and analyzed in accordance with the requirements of the receiving landfill. East of Colorado Boulevard the Near Surface Soil can be managed in the same manner as the Shallow Unsaturated Soil interval.

- Shallow Unsaturated Soil – Confirmation samples will be collected at the following frequency for a continuous excavation (an excavation that is not interrupted by unexcavated material within the same vertical horizon):

    1. One 10-point composite sample for every 500 cubic yards (cy) for the first 10,000 cy (20 composite samples).

    2. Provided the Non-impacted/Unrestricted or Impacted/Restricted Reuse criteria are met, and on-site reuse of the soil, sampling frequency can then be reduced to one 10-point composite for every 2,000 cy.

    3. Provided the Non-impacted/Unrestricted Reuse criteria are met, and planned reuse off-site, sampling frequency can be reduced to one 10-point composite for every 1,000 cy to a total

excavated volume of 100,000 cy. Then the sampling frequency can be further reduced to one 10-point composite for every 2,000 cy.

4. In the event that a material change in the soil type is observed, the excavation enters a site of concern noted in Appendix D, or potential contamination is identified during screening/sampling, the sampling frequency will return to the highest frequency described herein.

- Unsaturated Native Soil – Confirmation sampling is not necessary, except for parcels identified as Sites of Concern as outlined in Appendix D of this BRMMP, or parcels with potential impacts identified by the CM, in which case sampling will be in the same manner as Shallow Unsaturated Soil.
- Saturated Soil – Saturated Soil will be sampled in the same manner as Shallow Unsaturated Soil.

3.2.2 Sampling and Analytical Parameters

At a minimum, the following TAL will be utilized; however, the CM may supplement this list if historical, olfactory, visual, or prior sampling results deem it necessary:

- PAHs by USEPA Method 8270SIM;
- RCRA 8 metals by USEPA Method 6010B/7041;
- VOCs by USEPA Method 8260B; and
- Individual COCs will be further analyzed by the Toxicity Characteristic Leachate Procedure (TCLP), as discussed in Sections 3.2.3 and 4.1.

The results of the analysis will be compared to the RSLs (USEPA, 2017) and TCLP (USEPA, 2006)criteria, as applicable, followed by state and federal standards. All excavation spoils with COC concentrations below the RSL-1 will be deemed suitable for reuse on-site, within Project area boundaries, in accordance with Section 4. All excavation spoils exceeding RSL-1 and TCLP limits will be immediately managed as a hazardous waste and disposed off-site as a hazardous waste.

3.2.3 Waste Characterization

All excavation spoils with COC concentrations below the RSL-I will be deemed suitable for reuse on-site, within the Project boundary. If analytical results indicate that material is not suitable for reuse on-site, additional analysis may be necessary for waste characterization purposes. The receiving landfill should be consulted regarding their waste characterization requirements; however, at minimum, this testing should include the following:

- TCLP analysis for individual compounds exceeding the 20-times rule
- Flash Point by USEPA Method SW1010
- pH by USEPA Method SW9045C – Soil with free liquid only
- Paint Filter by USEPA Method 9095 – Soil with free liquid only
- Poly-chlorinated biphenyls (PCBs) – Evaluate based on site history or laboratory analysis

3.2.3.1 The 20-Times Rule

Licensed Subtitle-D landfills may accept solid material where concentrations, resulting from total concentration analysis, are less than 20 times the hazardous listing for characteristic waste (20-Times Rule), except for PCBs. USEPA TCLP Maximum Concentrations of Contaminants (USEPA, 2006) are presented as Appendix B. As an example, the regulatory level of lead is 5.0 parts per million (ppm). The acceptable limit for landfill disposal, using total metals analysis and the 20-Times Rule, would then be less than 100 ppm. If concentrations of any contaminant exceed the 20-Times Rule, then analysis by TCLP for that compound will be required. If the TCLP results exceed the toxicity characteristic maximum concentration, then the material would require disposal at a hazardous waste disposal facility in accordance with Section 4.1.4.

If final analytical results are below the 20-Times Rule concentrations, the material then may be eligible for transport and disposal at a licensed Subtitle-D landfill as non-hazardous solid waste, provided the material meets the waste acceptance criteria of the receiving landfill. The material may also be reused on-site, depending on the PAL designation of the material (Section 4.1.1, 4.1.2, and 4.1.3). Often, the RSL-I are less conservative than the landfill disposal requirements, so the on-site reuse of the material may be a more practical alternative (e.g. lead).

All wastes which are identified as hazardous waste shall be removed from the site for disposal at a facility permitted to received hazardous waste in accordance with local, state, and federal requirements.

4. Material Handling Procedure

All excavation spoils generated from within the Project area will be evaluated based on the procedures outlined in Section 3. In general, displaced soils that do not fail the "looks bad, smells bad" parameters or exceed the RSL-I, will be deemed suitable for reuse in accordance with Section 4.1.1 and 4.1.2.

4.1 Predetermined Action Levels

PALs will be used to determine if the soil is acceptable for reuse within the project area, off-site reuse, or requires disposal at an appropriate landfill. The PALs are based on the USEPA RSLs. For excavation spoils generated from the project area, the following exposures/scenarios will be considered:

- **Groundwater Protection** – These are often the most protective, or stringent values, and were developed to protect groundwater where a chemical compound in soil may leach into groundwater. If concentrations in soil exceed the groundwater protection value (GPV) on the CDPHE Groundwater Protection Soil Cleanup table (CDPHE, 2014b), indicating that the soil has the potential to impact water quality, individual compounds will be further analyzed using TCLP methodology. Additionally, TCLP analysis will be required for TALs that do not have an associated GPV (e.g., metals) and the material may be placed within five feet of the groundwater interface if TALs do not exceed GPVs or have TCLP concentrations exceeding the Colorado Basic Standards for Groundwater (GWS) (CDPHE, 2016b).

  TALs with TCLP concentrations exceeding the GWS will not be placed within five vertical feet of the groundwater table or will be properly disposed off-site.

- **Residential Protection** – These are the next most stringent values based on the USEPA RSL-Rs (USEPA, 2017), and are typically the concentrations where soil can be reused without restriction on any site, including residential property (except where values do not meet groundwater protection values, as described above).

- **Worker Protection** – These values are based on the RSL-I (USEPA, 2017) and are considered appropriate for commercial and industrial properties, and can be managed and/or reused at commercial/industrial locations within the Project area without restriction (except where values do not meet groundwater protection values, as described above).

The application of these values for making material handling decisions is discussed in the following sections.

4.1.1 Non-Impacted/Unrestricted Reuse

Soils with chemical concentrations at or below their applicable RSL-Rs may be reused at any site within the Project area or off-site location, assuming the groundwater protection values have been met. If groundwater protection values have not been met, the soil must be tested using TCLP (USEPA, 2006). If the TCLP values exceed the GWS, the material must be managed as Impacted – Restricted Reuse in accordance with Section 4.1.2.

4.1.2 Impacted/Restricted Reuse

Soil with chemical concentrations above the RSL-Rs (Resident Risk-Based Screening Level), as set forth in Appendix C, but below the applicable RSL-Is, may be reused in the Project area without limitation, provided placement is a minimum of five feet above the groundwater interface, and provided CDOT has or will be able to grant an EC for the area where these soils are placed. Soil that will be placed within five feet of groundwater must meet the groundwater protection criteria discussed in Section 4.1.

Soil with or without chemical concentrations above RSL-Rs, below RSL-Is (Composite Worker Risk-Based Screening Level), as set forth in Appendix C, and which contain some amount of debris (and therefore is considered by CDPHE as a "solid waste") without evidence of associated ACMs, may be reused in the Project area without restriction, provided placement is a minimum of five feet above the groundwater interface, and provided CDOT has or will be able to grant an EC for the area where these soils are placed. Soil that will be placed within five feet of groundwater must meet the groundwater protection criteria discussed in Section 4.1.

Soil meeting the Impacted/Restricted Reuse criteria, but not the Non-Impacted/Unrestricted Reuse, which is used as fill within the project area will be covered with at least one of the following:

- Asphalt or concrete meeting CDOT specifications for the planned land use
- Six-inches (compacted) of clean imported fill or soil meeting the Non-Impacted/Unrestricted Reuse criteria

CDOT and Contractors will map where soils meeting the Impacted/Restricted Use criteria are placed and may limit the EC to these areas. If CDOT and Contractors fail to or cannot map where such soils are placed, the EC will apply to the entire Project Area.

4.1.3 Health Risk/Disposal

Excavated soil that will not be reused on-site and that does not meet the RSL-Rs will be characterized and transported off-site for disposal at a facility appropriately licensed in accordance with local, state, and federal regulations.

4.1.4 Hazardous Waste

If sample analysis indicates that the soil is designated as hazardous waste, within 72 hours of receipt of TCLP results, the soil will be containerized in a lined container of appropriate size, labeled, and transported to a designated temporary storage area on-site for up to 90 days pending off-site disposal at a hazardous waste disposal facility appropriately licensed in accordance with local, state, and federal regulations. These wastes will be manifested and transported to the disposal facility in accordance with state and federal regulations.

Transportation and manifesting of these waste materials on public highways, streets, or roadways will be in accordance with 49 Code of Federal Regulations and any applicable state requirements.

4.2 Soil Segregation Procedures

If the construction Contractor identifies soil that meets any "looks bad, smells bad" parameters or that is classified as potentially impacted by the CM, the material will be segregated by criteria such as type of impact,

likely contaminants, soil type, and the stockpiles will be limited to a size that can be reasonably managed in accordance with this plan and applicable regulations, taking into consideration the stockpile location. Segregated material will be handled in accordance with procedures described in Section 3.1.

CDOT and the CM will compare the analytical results to the PALs, and appropriate disposal or reuse determinations will be made.

5. Reporting

Any entity conducting ground disturbing activities within the Project area, or following substantial completion of the Project, within any area restricted by an EC, including CDOT, Contractors, and Holders will be required to provide and maintain the documentation to justify and document how the material met the specific use criteria (on-site or off-site disposal) and the final disposition of the material. The CM is responsible for maintaining the following documentation, at a minimum, for all material that is handled under this BRMMP, which shall be updated at least daily during active construction:

- Property description (where the material was generated);
- Work description;
- Copies of all field logs which detail daily operations;
- Summary of field screening/observation results (may be included in the daily field logs);
- Summary of analytical results (if any);
- Summary of final disposition of the material (specific on-site location and associated cover material, if applicable or off-site location);
- Copies of all analytical reports (if any);
- Copies of all waste manifests (if any);
- Maps showing the locations of pertinent site features related to implementation of this BRMMP, including: sample locations, location of constructed sumps, locations of potential hazardous and/or special wastes, areas where fill, with concentrations above the RSL-R, was placed, and any other important features identified during the course implementation of this BRMMP;
- Global Positioning System (GPS) coordinates of the excavations, sample areas, subsurface features, and so on will be recorded whenever possible;
- Representative site photographs detailing work performed;
- For material reused on-site above the RSL-Rs, the material shall be mapped in accordance with the CDPHE GIS Mapping Requirements for Environmental Covenants (Appendix E).
- Any other documentation detailing important features related to this project; and
- Where no COCs are encountered, a simple Memorandum stating such will be provided.

This documentation must be made available to CDOT as stipulated in contract or easement documents and summary documentation will be provided to CDPHE on a monthly basis during active excavation within the Project area.

6. Post-Construction Material Handling Procedure

Soil meeting the Impacted/Restricted Use criteria but not the Non-Impacted/Unrestricted Reuse criteria that is beneficially reused within the Project area will be subject to an EC. These soils must be managed during any future excavation, drilling, grading, digging or tilling activities, even if such soil was blended during placement with soils meeting the Non-Impacted/Unrestricted Reuse criteria.

Wherever CDOT, Contractors, or Holders excavate, drill, grade, dig or till in areas where soils meeting the Impacted/Restricted Use criteria were placed, that party will restore site conditions in a manner consistent Section 4.1.2, i.e. Impacted soils are not placed within five feet of groundwater and are covered with asphalt, concrete, or six inches of compacted clean fill. Any Impacted soil that is not replaced must be sent to a licensed Subtitle-D landfill.

7. References

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CDPHE, 2014b. "Groundwater Protection Soil Cleanup Table," Colorado Department of Public Health and Environment, Denver, Colorado, March 2014.

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CDPHE, 2016b. "Regulation No. 41 – The Basic Standards for Groundwater, 5 CCR 1002-41," Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado December 30, 2016.

USEPA, 2006. "Table 1 - Maximum Concentration of Contaminants for the Toxicity Characteristic," 40 CFR 261.24, amended April 2006.

USEPA, 2017. "Regional Screening Level Calculator for Chemical Contaminants at Superfund Sites," United States Environmental Protection Agency, (September 9, 2017). https://semspub.epa.gov/work/03/2245073.pdf.

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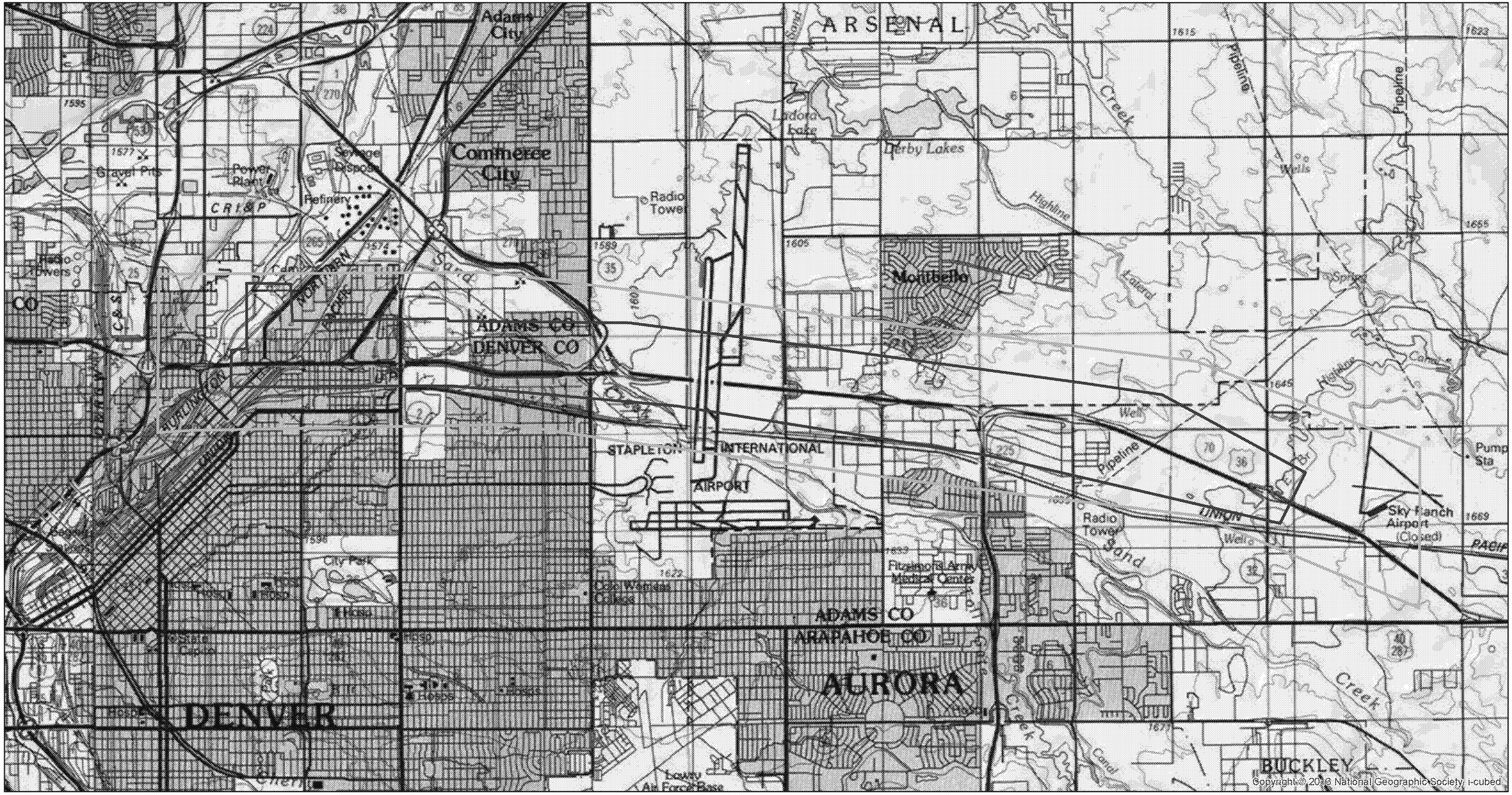

N

Legend

Project Boundary

Project Location

0 2,500 5,000 Feet

Pinyon

SITE LOCATION

CDOT I-70 Central Project
Denver, Colorado

Site Location: Denver, Colorado	Drawn By: MJS	Figure 1
Pinyon Project Number: 1/12-790-04.8026.2	Reviewed By: RMT	Date: 8/4/2016

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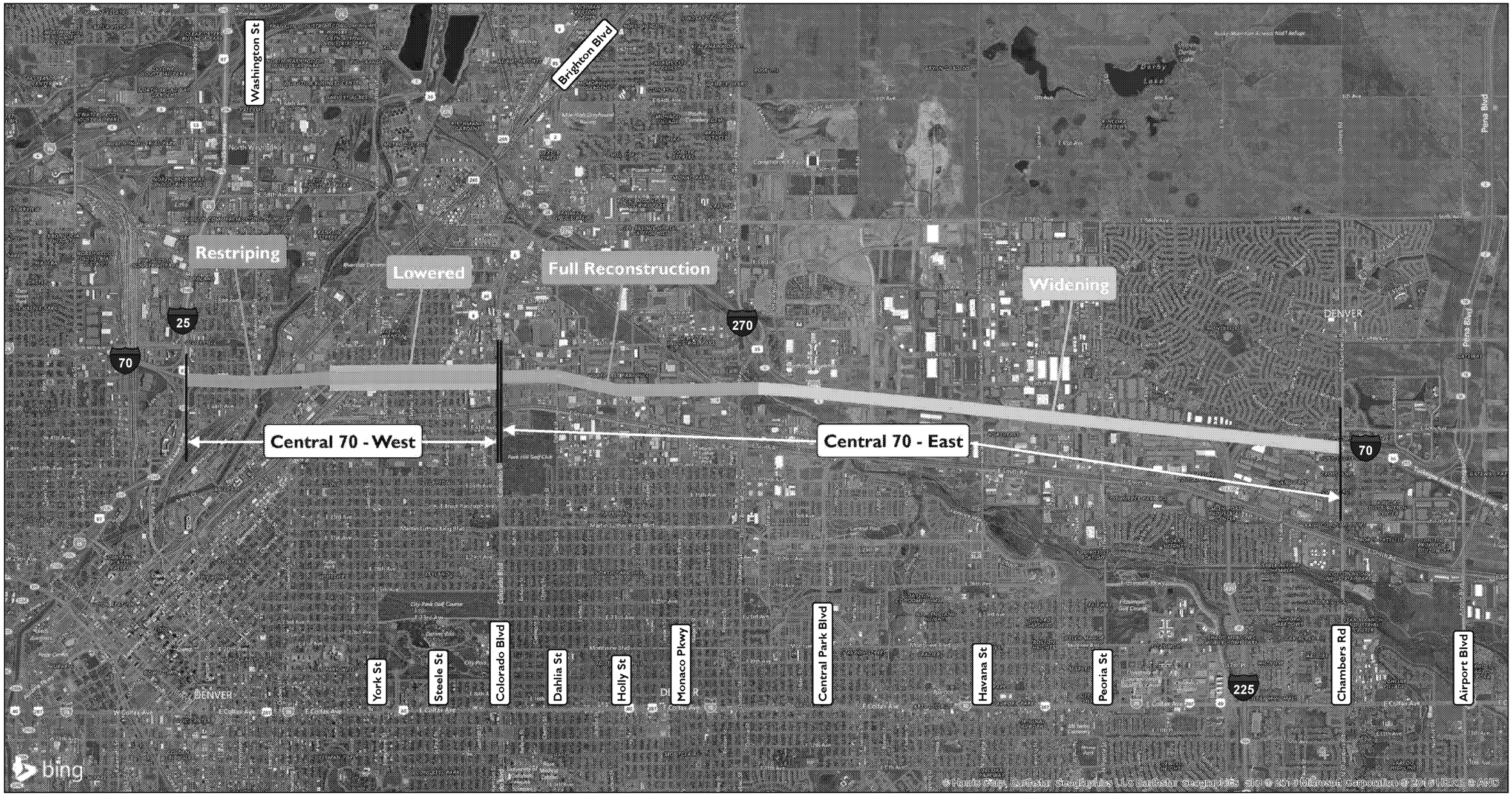


N

Legend

- Restriping
- Widening
- Full Reconstruction
- Lowered

0 2,000 4,000 Feet

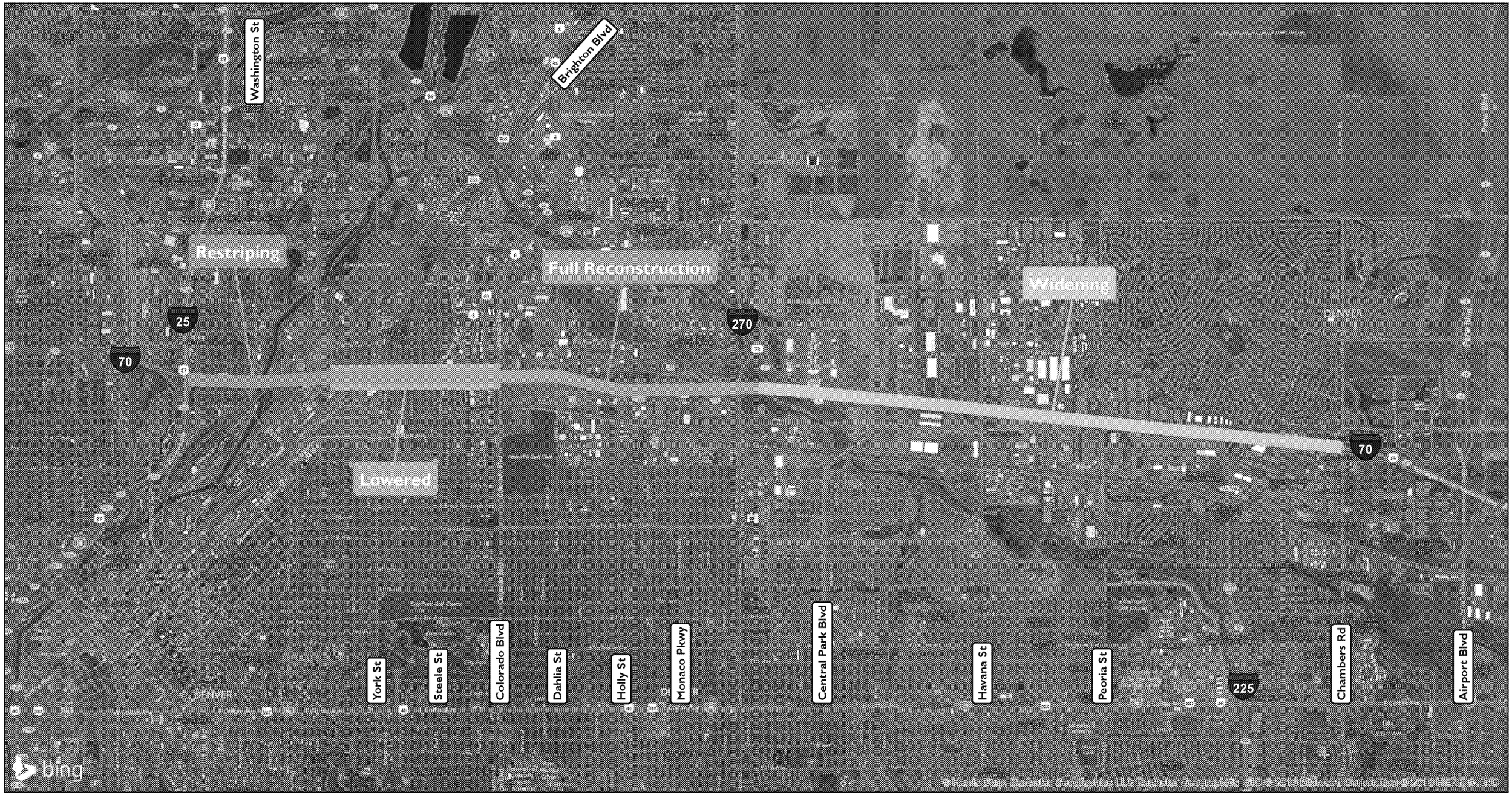
Pinyon

PROJECT OVERVIEW

CDOT I-70 Central Project
Denver, Colorado

Site Location: Denver, Colorado	Drawn By: MJS	Figure 2
Pinyon Project Number: 1/12-790-04.8026.2	Reviewed By: RMT	Date: 8/29/2016

Document Path: C:\Users\Santo\Desktop\Figure 2 - Project Overview.mxd



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Legend

- Restriping
- Widening
- Full Reconstruction
- Lowered

0 2,000 4,000 Feet

Pinyon

PROJECT OVERVIEW

CDOT I-70 Central Project
Denver, Colorado

Site Location: Denver, Colorado	Drawn By: MJS	Figure 3
Pinyon Project Number: 1/12-790-04.8026.2	Reviewed By: RMT	Date: 8/4/2016

Document Path: D:\PROJECTS\2012\11279004 I-70 East DEIS\Figures\ArcMap\MXDs\Figure 3 - Project Overview.mxd

Appendix A CDOT Regulated Asbestos-Contaminated Soil Management Standard Operating Procedure

COLORADO
Department of Transportation
Office of the Chief Engineer

REGULATED ASBESTOS-CONTAMINATED SOIL MANAGEMENT STANDARD OPERATING PROCEDURE

October 18, 2016

Prepared by:
CDOT
Property Management Section
Hazardous Waste Unit
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Golden, CO 80401

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Asbestos Program Manager
Certified Building Inspector #1831

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TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE 1-1

2.0 PRIMARY CONTACTS, ROLES AND RESPONSIBILITIES 2-1

3.0 DEFINITIONS AND ABBREVIATIONS 3-1

3.1 Abbreviations 3-1
3.2 Definitions 3-1

4.0 PERSONNEL QUALIFICATIONS AND OUTREACH 4-1

5.0 MATERIALS AND EQUIPMENT 5-1

6.0 PROCEDURES 6-1

6.1 Unexpected Asbestos Discovery 6-1

6.1.1 Sampling RACS and/or ACM, Unexpected Asbestos Discovery 6-2
6.1.2 Assumed RACS and/or ACM, Unexpected Asbestos Discovery 6-3
6.1.3 Limited Quantity Unexpected Asbestos Discovery and Management 6-3

6.2 Excavation and Earthmoving, Known RACS (Planned Encounter) 6-5
6.3 Excavation and Earthmoving, Suspect RACS (Possible Encounter) 6-9
6.4 RAC Spill Response 6-9

7.0 AIR MONITORING REQUIREMENTS 7-1

7.1 Personal Air Monitoring 7-1
7.2 Perimeter Air Monitoring for Asbestos 7-1
7.3 Air Sample Analysis and Response to Detected Asbestos Fibers 7-1

8.0 DOCUMENTATION 8-1

9.0 EQUIPMENT AND WORKER DECONTAMINATION PROCEDURES 9-1

9.1 Equipment Decontamination 9-1
9.2 Worker Decontamination 9-2

10.0 Disposal 10-4

11.0 Remaining RACS and/or ACM 11-1

12.0 Reporting 12-1

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ATTACHMENTS

Attachment 1	CDPHE Asbestos-Contaminated Soil Notification Forms
Attachment 2	CDOT Field Documentation Forms

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1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides written standard operating procedures that are the minimum requirements for the proper training, handling, packaging, and disposal of regulated asbestos-contaminated soil (RACS) or asbestos-containing material (ACM) during soil disturbing activities for Colorado Department of Transportation (CDOT) properties. This SOP shall be followed whenever soil excavation or disturbance will occur in areas where asbestos is known or suspected to exist. This SOP satisfies the current Section 5.5 Regulations (Management of Regulated Asbestos Contaminated Soil (RACS) of the Colorado Solid Waste Regulation (6 CCR 1007-2, Part 1).

When using this SOP for a specific project, appropriate notification shall be provided to Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division (CDPHE) using the CDPHE notification forms attached to this SOP (Attachment 1). Note that for existing projects, where project information has already been provided to CDPHE, notification shall be provided to the established CDPHE contact, and use of the forms in Attachment 1 may not be necessary. Specific project notification under this SOP should include the following supplemental information:

1) A general project description,
2) A description of the area that work will take place,
3) Maps of the project area,
4) Project specific contact information (phone and email) including the general contractor, the excavation contractor (if not the general), the General Asbestos Contractor (GAC)(if applicable), and the environmental consultant,
5) Types of debris/contamination (either confirmed or assumed)that have been encountered,
6) Any interim steps that have been taken,
7) Any deviations from the approved SOP (with notation that any deviations will have to be approved by the CDOT and CDPHE before being implemented).

The SOP should be used as a guideline for implementing appropriate management and disposal practices, and may be supplemented with additional site specific management plans, including amended Material Management Plans for other regulated material, and/or Health and Safety Plans for site-specific safe work practices. Site specific Material Management and/or Health and Safety Plans will be appended to this SOP, and submitted to the CDPHE using the same CDPHE notification requirements noted above.

2.0 PRIMARY CONTACTS, ROLES AND RESPONSIBILITIES

Organization	Role/Responsibility	Contact Information
Colorado Department of Transportation (CDOT)	Property Management Section, Hazardous Waste Management Unit Supervisor	Theresa Santangelo-Dreiling Phone: 303.512-5524 Mobile: 303.917-6528 Email: Theresa.santangelo@ state.co.us
	Asbestos Program Project Manager	Phil Kangas, Phone: 303.512-5519 Mobile: 303.325-6123 Email: phillip.kangas@ state.co.us
	Project Management	CDOT Project Engineer
Contractors	Site excavation and as needed management of RACS in accordance with this SOP	To be provided per Project specific notification
Environmental Consultant	Soil characterization, soil removal oversight, soil spotting, air monitoring	To be provided per Project specific notification

3.0 DEFINITIONS AND ABBREVIATIONS

3.1 Abbreviations

ACM	Asbestos-containing materials
AHERA	Asbestos Hazard Emergency Response Act
AIHA	American Industrial Hygiene Association
AMS	Asbestos Air Monitoring Specialist, CDPHE Certified
APD	Asbestos Project Designer
AQCC	Air Quality Control Commission
CABI	Certified Asbestos Project Designer
CCR	Code of Colorado Regulations
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
DOT	US Department of Transportation
EPA	US Environmental Protection Agency
f/cc	fibers per cubic centimeter
GIS	Geographic information system
GPS	Geographic positioning system
HASP	Health and Safety Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Lab Accreditation Program
OSHA	Occupational Safety and Health Administration
PCM	Phase Contrast Microscope
PLM	Polarized Light Microscopy
PPE	Personal Protective Equipment
QPM	Qualified Project Monitor
RACS	Regulated Asbestos-Contaminated Soil
RWA	Regulated Work Area
SOP	Standard Operating Procedure document
TEM	Transmission Electron Microscopy

3.2 Definitions

"Air Monitoring Specialist" means a person who performs air monitoring who is certified to perform air monitoring in accordance with Air Regulation No. 8, Part B.

"Adequately wet" means sufficiently mix or penetrate with liquid to completely prevent the release of particulate material and fibers into the ambient air. If visible emissions are observed

coming from asbestos-contaminated soil or asbestos-containing material, then the material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wet. Guidance on determining when a material is adequately wet can be found in EPA's *Asbestos NESHAP Adequately Wet Guidance*, EPA 340/1-90-019 (December 1990).

"Asbestos" means the asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), amosite (cummingtonite-grunerite), anthophyllite, and actinolite-tremolite.

"Regulated Asbestos Contaminated Soil" ("RACS") means soil, ash, or debris (plus six (6) inches in all directions of surrounding soil or other matrix material) containing:

1) **Friable asbestos-containing materials (ACM) as determined in the field by a Certified Asbestos Building Inspector (CABI) through a RACS determination;**
2) **Previously non-friable ACM(s) that have been rendered friable as determined in the field by a CABI(s) through a RACS determination;**
3) **Non-friable ACM(s) that have a high probability of releasing fibers based on the forces expected to act upon the material during soil disturbance as determined in the field buy a CABI(s) through a RACS determination;**
4) **Deteriorated non-friable ACM(s) that are in poor condition resulting in a high probability to release fibers due to weathering, historical mechanical impact, fire damage (by evidence of ACM within an ash layer) or other factors as determined in the field by a CABI(s) through a RACS determination;**
5) **The following broken, resized, or damaged ACM(s) are RACS:**
    a. **Asbestos cement materials**
    b. **Plaster**
    c. **Brittle caulking, glazing and sealants**
    d. **Powdery Concrete Masonry Unit (CMU) sealant**
    e. **Powdery floor leveling compound**
    f. **Drywall/wallboard and associated joint compound material**
    g. **Firebrick**
    h. **Other material as determined by the Department, at the request of the owner or person disturbing debris, to have a high probability to release fibers.**
6) **Soil or ash known to contain non-visible asbestos fibers based on documented evidence.**

"Non-Regulated Asbestos Contaminated Soil" (Non-RACS)" means soil or debris that contains only:

1) Intact non-damaged, non-friable ACM; or,
2) Damaged non-friable ACM(s) that do not have a high probability to release fibers based on the forces expected to act upon the material during disturbance as determined in the field by a CABI(s) through a "RACS Determination". The following ACM(s) are predetermined to be Non-RACS:

i. Resin based materials including but not limited to phenolic-plastic (Bakelite), used in electrical and mechanical parts;

j. Resilient flooring (vinyl, asphalt, rubber) excluding non-tar impregnated friable felt backing on sheet vinyl flooring (linoleum);

k. Tar impregnated or asphaltic materials in good condition that have not become brittle;

l. Elastic, pliable, or rubberized materials, including but not limited to:

i. Pliable duct sealant(s);
ii. Pliable fiberglass insulation sealant;
iii. Pliable fire-stop caulking/sealants;
iv. Pliable window and door caulking

m. Extremely hard materials, coatings and sealants including but not limited to:

i. Laboratory countertops and sinks;
ii. Epoxy type CMU coatings;
iii. Epoxy type panel adhesive;
iv. Duct sealant;
v. Ceiling tile adhesive

n. Other ACM(s) as approved by the CDPHE at the request of the owner or person disturbing debris, to not have a high probability to release fibers.

"Asbestos Supervisor" means a person who has been certified as an asbestos Supervisor in accordance with Air Regulation No. 8, Part B.

"Asbestos Project Designer" or **"Project Designer"** means a person who has been certified as an asbestos Project Designer in accordance with Air Regulation No. 8, Part B.

"Asbestos waste" means any asbestos-containing material whether it contains friable or non-friable asbestos, that is not intended for further use. This term includes but is not limited to asbestos mill tailings, asbestos from pollution control devices, and containers that contain asbestos.

"Asbestos-containing material" means any material that contains more than one percent (1%) asbestos by weight, area or volume.

"Certified Asbestos Building Inspector" (CABI) means a person certified in accordance with Air Regulation No. 8, Part B, to perform asbestos inspection and sampling (asbestos inspector).

"Debris" means the remains of any non-earthen material that has been discarded, broken down, destroyed, or burned.

"Facility Component" means any component associated with a structure, installation, or building and includes buried utilities, tanks, structures or other installations.

"Friable" means that the material, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure, and includes previously non-friable material after such previously non-friable material becomes damaged to the extent that when dry it may be crumbled, pulverized, or reduced to powder by hand pressure.

"Fugitive Dust" means visible dust leaving the work area boundary.

"Leak tight" means that solids, liquids, or gases cannot escape or spill out. It also means dust tight.

"Mechanical" means operated or produced by mechanism or machine. This may include, but shall not be limited to, an excavator, backhoe, grader and/or tiller.

"Non-friable" means material which, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

"Qualified Project Monitor" (QPM) means an individual who has the training and/or experience necessary to identify materials suspected of containing asbestos and who has the authority to make prompt decisions to the management of such materials, and who meets the training requirements in Colorado Solid Waste regulations Section 5.5.3.

"RACS Determination" means a determination conducted in the field by a CABI, of the friability of ACM and the probability of non-friable ACM to release fibers based on the condition of the material and the forces that are expected to act on it during disturbance. Determinations of friability shall be based on the requirements for such determination set forth in Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B). Determinations of the probability for non-friable ACM to release fibers during disturbance shall be based on the following:

1) **The condition of the material prior to disturbance, based on observations of weathering, the integrity of the material, historical mechanical impact, or fire damage;**
2) **The potential for the material to be broken, resized or damaged during planned disturbance;**
3) **The material shall be considered RACS if the planned disturbance includes any of the following:**
   a. Augers;
   b. Rotary style trenchers;
   c. Driving on ACM lying on the surface (vehicles or equipment);
   d. Blasting or other detonation;
   e. Intentional burning;
   f. Other types of direct mechanical impact which are:
      i. In direct contact with ACM or result in observation of ACM after disturbance, and,
      ii. Causing damage to the ACM

"Regulated Work Area (RWA)" means the area where soil disturbing activities involving RACS are occurring. For RACS disturbance, Regulated Work Area also means the regulated/controlled area boundary.

"Site" means the area or areas where soil-disturbing activities are occurring or will occur.

"Staging" for the purposes of Section 5.5 and this SOP, means the accumulation of RACS in the RWA for twelve (12) hours or less.

Stockpiling" for the purposes of Section 5.5 and this SOP, means the accumulation of RACS that will exist for more than 12 hours, up to and including ten (10) calendar days.

"Storage" for the purposes of Section 5.5 and this SOP, means the accumulation of RACS greater than ten (10) days, but not exceeding six (6) months.

"Soil-disturbing activities" means excavation, grading, tilling, or any other mechanical activity used to disturb the soil.

"Visible emissions" means any emissions which are visually detectable without the aid of instruments, coming from material containing asbestos, asbestos waste, asbestos-contaminated soil, or from handling and disposal of asbestos waste, material containing asbestos or asbestos-contaminated soil.

4.0 PERSONNEL QUALIFICATIONS AND OUTREACH

Community outreach shall be conducted for projects involving mechanical disturbance of RACS containing friable ACM with an adjacent receptor present. In addition, ancillary worker awareness briefing(s) shall be conducted through the dissemination of fact sheets and/or informational meetings that discuss the presence of RACS that includes friable ACM and the measures being taken to prevent emissions and cross contamination.

Personnel overseeing, directing, inspecting and/or handling soil (known or suspected of containing asbestos) shall have, at a minimum and as appropriate to the work activity, the following training and experience:

1) Projects involving the disturbance of debris or soil/ash containing debris shall include at least one onsite QPM during active disturbance;
2) Personnel inside the RWA during the disturbance of RACS shall have annual awareness training. This training requirement applies to equipment operators and drivers of trucks carrying contaminated material for offsite disposal or reuse. Truck drivers who do not complete this training are ancillary workers. Soil disturbing activities must cease if the truck driver is present in the RWA unless the driver remains in the cab of the truck, the truck windows and doors remain closed, and the air handling system remains off while the truck is in the RWA. This training shall cover information necessary to comply with Solid Waste Regulation 5.5 including:
    - General asbestos awareness; including health effects; and
    - Overview of the requirements of Section 5.5; and
    - Overview of suspect ACM that requires further evaluation by a CABI; and
    - Overview of RACS and Non-RACS; and
    - Worker protection, including levels of personal protection equipment (PPE) required for various activities and conditions; and
    - Decontamination requirements for equipment and personnel; and
    - Engineering controls to prevent the release of asbestos outside the RWA; and
    - Overview of RACS handling procedures. The training shall be conducted by a CABI who is familiar with the site specific plan and/or the Minimum Requirements in Solid Waste Regulation Section 5.5.7. Records of this training shall be retained, by the trained individual, and be available for inspection, for a minimum of one year from the date of the training.
3) Per-project site-specific awareness training for disturbing RACS. This training shall cover site-specific information necessary to comply with Solid Waste Regulation Section

5.5 and the selected management approach for the project (this SOP or the minimum requirements of Solid Waste Regulation Section 5.5.7, including project chain-of-command and identification of authorized personnel with stop work authority, and identification of QPM(s), and hands on training specific to the soil disturbing activities involving RACS the individual will be performing. This training shall be provided by a CABI. Records of this training shall be retained, and be available for inspection, for the duration of the project for which the training was conducted. Individuals performing abatement of facility components, in accordance with Section 5.5.1 (B) of the Colorado Solid Waste Regulation, shall be Colorado Certified Asbestos Workers and/or Supervisors (Air Quality Control Commission (AQCC), Regulation No. 8, Part B,). If trigger levels of facility components are exceeded (see Section 6.3.7), then AQCC Regulation No. 8, will be followed with a Certified Project Designer, developing the abatement plan and submitting the permit request;

4) Qualified Project Monitors shall have, at a minimum:

- Annual awareness training and site specific awareness training under Solid Waste Regulation Section 5.5.3 (A) and (B); and
- Training from a CABI on identifying debris, exempted materials under Section 5.5.1 (A)(3), and the assumption of debris to be RACS as outlined in Section 5.5.1; and
- Training from a CABI on how to implement the minimum requirement under Section 5.5.7 and how to perform the duties that a QPM may perform in lieu of a CABI; and
- Training from a CABI on how to implement the provisions of this SOP or minimum requirements of Solid Waste Regulation Section 5.5.7 and how to perform the duties that a QPM may perform in lieu of a CABI; and
- 40 verifiable hours of direct experience on projects conducted under Solid Waste Regulation 5.5.

5) Inspection and identification of RACS shall be conducted by a CABI (certified in accordance with AQCC Regulation No. 8 (5 CCR 1001-10, Part B)), with 40 verifiable hours of on the job asbestos in soils experience on a minimum of three (3) different asbestos in soils jobs, conducted under either AQCC Regulation No. 8 or Section 5.5. The CABI shall be independent of the general contractor (GC) and/or abatement contractor unless the CABI and the GC or abatement contractor are both direct employees of the property owner. However, the GC or abatement contractor may hire a subcontractor CABI, but the CABI shall not be a direct employee of the GC or abatement contractor.

6) Individuals performing air monitoring in accordance with Solid Waste Regulation Section 5.5 must have a current Air Monitoring Specialist (AMS) certification in accordance with AQCC Regulation No. 8 (5 CCR 1001-10, Part B).

All personnel working on the site shall be advised and directed to not disturb areas (unless conducting asbestos inspections under Section 6.0) where suspected or known asbestos is present. Personnel driving onto the site shall be notified of suspect or known asbestos locations and directed to not drive on or otherwise disturb those areas.

5.0 MATERIALS AND EQUIPMENT

The following materials may be needed during the course of discovery, inspection or excavation of ACM or RACS:

1) Appropriate field monitoring instruments (low flow air sampling pumps, personnel pumps, wind meters, Phase Contrast Microscopy (PCM) microscopes, etc);
2) Camera (35 millimeter or digital), field logbooks;
3) Personal Protective Equipment (PPE) and cold weather gear as required;
4) Tape measure and pin flags;
5) Garden trowels and/or rakes;
6) Shovels, wheelbarrow;
7) Garden sprayers;
8) Marked labels stating "Caution - Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm;"
9) 6-mil thickness polyethylene disposal bags;
10) Sample bags, generator labels, and manifests;
11) 6-mil, or greater, polyethylene sheeting;
12) Soil sampling supplies (sample containers or plastic bags, labels, chains-of-custody, coolers, collection bowl, decontamination supplies);
13) Suitable lab/sample reading area; and,
14) Documentation forms.

Larger investigation or excavation projects may require additional equipment such as a backhoe, trailer-mounted sprayers, or water trucks for more extensive dust control measures, and investigation-derived waste (IDW) containers such as roll-off bins or drums with single or double plastic liner, depending on the friability of the asbestos.

6.0 PROCEDURES

6.1 Unexpected Asbestos Discovery

It is possible that RACS and/or ACM may be unexpectedly encountered during any CDOT excavation project. Upon initial discovery of any unexpected asbestos (RACS or ACM) field personnel who are not CABIs shall immediately stop work and notify CDOT. **Notification to CDOT shall include notification to the CDOT Project Engineer and the CDOT Asbestos Program Project Manager as provided in Section 2.0 of this SOP.** The Contractor shall notify and receive approval from the CDOT Asbestos Program Project Manager prior to any work completion in any areas of unexpected RACS or ACM discovery.

Field personnel shall take actions necessary to assure that the suspect material is not disturbed while waiting for appropriately trained personnel to arrive on site. Field personnel shall stake, flag, demarcate or measure and/or mark on a map the suspect materials and warn crews to avoid that area until directed otherwise. Field personnel shall establish and take measures to manage RACS in accordance with Section 5.5 and this SOP including: taking measures to prevent access to the RWA by unauthorized persons; conducting interim surface soil stabilization to reduce emissions including:

a. Polyethylene sheeting with daily inspection, and inspection after storm events, and repair/replacement of sheeting as necessary to maintain stabilization; or
b. Chemical stabilization demonstrated to be effective in the stabilization of RACS (e.g. magnesium chloride) with weekly inspection, and inspection after storm events, and re-application of chemical stabilizer as necessary to maintain stabilization; or
c. Minimum of 3 inches of soil appropriate for unrestricted use; or
d. Other means of stabilization as approved by the CDPHE and CDOT.
e. Stabilization is not required if RACS is kept adequately wet. Verification of adequately wet conditions shall be conducted at least every two hours, or RACS shall be stabilized.

Equipment that was being used when encountering the suspect material is to be held unused for proper decontamination by wet or HEPA vacuum methods per Solid Waste Regulation 5.5.7 (I) until the suspect material is confirmed by lab analysis as asbestos or not.

In addition, the CDPHE will be notified within 24 hours of an unexpected RACS and/or ACM discovery. The Contractor or Consultant may notify CDPHE on the behalf of CDOT. The CDPHE can be notified by using the Notification Form attached to this plan, and mailed to: Colorado Department of Public Health and Environment, HMWMD-B2, Solid Waste Compliance Assurance Unit, 4300 Cherry Creek Drive South, Denver, CO 80246-1530, Attn: Brian Long or emailed to briant.long@state.co.us. Notification forms are provided in Attachment 1 to this plan. **For emergency repair projects to utilities, etc, notification will be**

provided to CDPHE by the next business day. Note that for existing projects, where project information has already been provided to CDPHE, notification shall be provided to the established CDPHE contact, and use of the forms in Attachment 1 may not be necessary.

The appropriately trained CDOT CABI (see Section 4.0) shall handle activities beyond initial discovery, including but not limited to the following:

1) Conducting inspections to assess the presence and extent of asbestos;
2) Documenting, collecting, packaging, and transporting suspect asbestos; and,
3) Directing qualified personnel to conduct items mentioned above.

At a minimum, appropriate PPE must be worn when doing asbestos inspections or otherwise accessing an area suspected or known to contain asbestos. At a minimum, CABIs performing the inspection and/or pickup of Non-RACS (just the ACM) must wear disposable booties and rubber gloves, which should then be discarded as asbestos waste prior to exiting the site.

Personnel completing the pickup of RACS (the piece and 6 inches in all directions of associated soil and/or debris or other matric material) plus an additional 6 inches, in all directions, of soil and/or debris or other matrix material from the last occurrence of visible RACS (Sections 6.2 and 6.3), must wear disposable outer protective clothing, booties and rubber gloves, which should then be discarded as asbestos waste prior to exiting the site. Additional PPE requirements may be required as determined by the Contractor's Health and Safety Officer. Refer to Section 9.0 of this SOP for personnel and equipment decontamination procedures.

If the RACS and/or ACM is pervasive throughout the excavation area, other protective measures, such as additional wetting and wind fencing, shall be employed. The CABI, in consultation with the CDOT Asbestos Program Project Manager, is allowed to make judgment calls on the initiation of additional protective measures and the amount of soil to be removed (the amounts of soil to be removed listed above are minimums, CDOT may elect to remove additional soils)(Sections 6.2 and/or 6.3).

6.1.1 Sampling RACS and/or ACM, Unexpected Asbestos Discovery

Unexpected suspect ACM encountered during a project must either be sampled and laboratory analyzed for asbestos or assumed to be asbestos containing. At the request and discretion of CDOT, the CABI may collect for analysis representative samples of each type of the unexpected material(s) encountered. Sampling of suspect RACS and/or ACM will include:

1) Adequately wet the suspect material to be sampled and the immediately surrounding soil. Collect the suspect asbestos material and place it in appropriate sample containers such as sample bags or jars;
2) Submit the material(s) for analysis to a certified asbestos lab for PLM analysis using proper chain-of-custody protocol; and,

3) Take digital photographs of the suspect RACS and/or ACM. Complete a photographic log for each type of suspect RACS or ACM sampled. The photographic log shall contain the location, date and time of each sample, a description of the suspect RACS or ACM, degree of friability, and the laboratory results.

Once identified as known RACS and/or ACM, and if the material(s) does not meet the criteria for Limited Quantity Unexpected Asbestos Discovery and Management as described in Section 6.1.3, the RACS and/or ACM will be then be managed, handled, packaged, disposed of and/or left in place as described in the applicable portions of Sections 6.2 through 11.0.

6.1.2 Assumed RACS and/or ACM, Unexpected Asbestos Discovery

As an alternative to sampling, the suspect RACS and/or ACM may be assumed to contain asbestos, with no material sample collection or laboratory analysis conducted. Assuming that suspect RACS and/or ACM contains asbestos will be at the discretion of CDOT. If suspect RACS and/or ACM is assumed to contain asbestos, the CABI will

1) Take digital photographs of the suspect RACS and/or ACM; and,
2) Complete a photographic log for each type of suspect RACS or ACM identified. The photographic log shall contain the location, date and time of each sample, a description of the suspect RACS or ACM, and degree of friability.

Once suspect RACS and/or ACM is assumed to contain asbestos, and if does not meet the criteria for Limited Quantity Unexpected Asbestos Discovery and Management as described in Section 6.1.3, the RACS and/or ACM will be then be managed, handled, packaged, disposed of and/or left in place as described in the applicable portions of Sections 6.2 through 11.0.

6.1.3 Limited Quantity Unexpected Asbestos Discovery and Management

If soil in an area not known or suspected to have asbestos contamination is determined to contain positively identified (through sampling) or assumed RACS which has less than 25 separate pieces of asbestos **in a single location that is less than 10 cubic feet** (with multiple pieces of asbestos within a few inches of each other to be treated as one piece of asbestos), the CABI may, at the request and discretion of CDOT, remove these pieces of asbestos using the procedures listed below:

1) Use amended water (surfactant consisting of one ounce of a solution of 50% polyoxyethylene ester and 50% polyoxyethylene ether or equivalent in a 0.16 percent solution (1 ounce to 5 gallons of water) or as per manufacturer recommendations for the wetting of asbestos available to adequately wet the material and surrounding soil. This requirement may be waived by the CDPHE for emergency situations where the work must occur immediately and wetting agents are not available;
2) For Non-RACS, wet, gather and place the material in 6 mil bags;
3) For RACS, wet, gather and place material and 6 inches in all directions of associated soil and/or debris or other matric material plus an additional 6 inches, in all directions, of soil

and/or debris or other matrix material (total of 12 inches of removal in all directions) from the last occurrence of visible RACS in 6 mil bags (double bags). Continue work with extra attention to possible additional asbestos in that vicinity;

4) Stage waste bags in a lined drum or roll-off container. Document waste as solid waste, which contains asbestos, on CDOT Field Documentation Forms (Attachment 2);

5) Conduct a follow-up visual inspection of the area by repeating procedures 1 through 4 above;

6) If no more visible asbestos material is discovered, and at the request and discretion of CDOT, the CABI may proceed with area clearance by collecting a 10-point composite soil sample over the area (maximum area of 1,250 SF). Aliquot locations shall be representative of the entire area; however, aliquots must be placed where any visible friable asbestos material was found. Sampling shall be performed by following these procedures:

   i. Calculate the volume of sample material to be collected at each increment sample to ensure the necessary amount of composite sample shall be obtained. For a given composite sample, the volume of each incremental sample shall be approximately one (1) tablespoon and must equal 1/10 of the required composite sample volume of between ¼ cup and 1 cup.;

   ii. Use a decontaminated stainless steel spoon to collect a surface soil sample. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel-size or large particles and debris based on visual observation;

   iii. Decontaminate the sampling equipment in accordance with Section 9.0; and,

   iv. Submit the material(s) for analysis using proper chain-of-custody protocol.

7) All samples shall be analyzed using accepted PLM methodology for asbestos bulk samples by laboratories accredited according to the provisions set forth in AQCC Regulation No. 8. Proper chain-of-custody protocols for all samples submitted shall be followed. All samples will be prepared by the laboratory in accordance with Solid Waste Regulation Section 5.5 Appendix 5A Analytical Requirements prior to sample analysis.; and,

8) Dispose of waste in marked 6 mil bags with affixed generator labels. Waste shall be double-bagged if picked up during inspection. All waste must be disposed in accordance with Section 5 of the Colorado Solid Waste Regulations.

If no asbestos fibers are detected in the composite sample, the area will be classified as non-RACS and the area will remain classified as no reason to know or suspect RACS. If asbestos fibers are detected in the composite soil sample, the area will be classified as known RACS. The known RACS will then be managed, handled, packaged, disposed of and/or left in place as described in the applicable portions of Sections 6.2 through 11.0. Following any discovery of

RACS and/or ACM subsequent soil disturbing activities should be conducted with the understanding that further encounters with RACS are possible and that Solid Waste Regulation 5.5 will be implemented. If soil disturbing activities will last longer than two (2) days then air monitoring procedures will be performed per Section 5.5.7 (E).

6.2 Excavation and Earthmoving, Known RACS (Planned Encounter)

This section applies to soil disturbing activities in areas at which RACS have been identified.

Establishment and control of Regulated Work Area (RWA)

1) Requirements for establishment and control of a RWA are applicable to all projects subject to Solid Waste Regulation Section 5.5 and this SOP including Section 6.1.3 work stated above:
    a) Establish a RWA that is identifiable to all persons. Haul roads between RWAs, where RACS is not present, are considered to be outside the RWA)s); however, equipment decontamination and spill responses procedures shall be followed; and
    b) Stop all soil disturbing activities in the RWA if ancillary workers or members of the public are present within the RWA. Truck drivers who do not complete the asbestos awareness training are ancillary workers. Soil disturbing activities must cease if the truck driver is present in the RWA unless the driver remains in the cab of the truck, the truck windows are closed and the air handling system remains off while the truck is in the RWA; and
    c) Post labeling and signage to demarcate RWA(s). The RWA shall be demarcated with a visual means that fully defines the extent of the RWA. Labeling and signage shall indicate the presence of asbestos, and that the area is off limits to unauthorized personnel.
2) Additional Requirements for Projects Disturbing RACS Containing Friable ACM. Establish a secured work site (e.g., fencing/locks/zip-ties/chains). Security firms, personnel, or staff subcontracted/assigned to this duty, may be used to secure the RWA in lieu of fencing. If the RWA is located within a larger secure facility fencing of the RWA is not necessary as long as the RWA is secured.

The CDPHE will be notified at least 10-days prior to any planned soil-disturbing activity in areas of known RACS and/or ACM. The CDPHE can be notified by using the Notification Form attached to this plan, and mailed to: Colorado Department of Public Health and Environment, HMWMD-B2 Attn: Brian Long, Solid Waste Compliance Assurance Unit, 4300 Cherry Creek Drive S., Denver, CO 80246-1530 or emailed to briant.long@state.co.us. The CDPHE Notification form is provided in Attachment 1 to this plan. **For emergency repair projects to utilities etc., notification will be provided to CDPHE by the next business day. Note that for existing projects, where project information has already been provided to CDPHE, notification shall be provided to the established CDPHE contact, and use of the forms in Attachment 1 may not be necessary.**

Dust control measures shall be increased significantly during soil disturbing activities in areas of known RACS. Dust control during soil disturbing activities shall be continually assessed and modified as needed to best accommodate changing site conditions. Visible dust emissions shall not be generated at any time during any soil disturbing activities.

Important: Unless specified in the CDOT construction documents and Contractor's Health and Safety Plans, personnel shall not enter an excavation without the proper safety precautions. Substantial local, state, and federal regulations and site-specific health and safety requirements apply for entry into excavations. CDOT and/or the Contractor's Health and Safety Officer must be notified prior to any activity involving entry of personnel into excavations.

1) The air monitoring requirements specified under Section 7.0 shall be followed during soil disturbing activities;
2) Wind speed measurements will be taken with a hand held wind meter at least every 30 minutes, and during wind gusts, throughout the duration of soil removal or disturbance activities. All inspection and excavation procedures within 100 feet of friable RACS or ACM, including non-friable that have been or have the potential to be rendered friable, in this SOP must cease when any of the following wind stoppage criteria are met, in order to limit potential exposure to workers and airborne emissions of asbestos from the site. The following wind stoppage criteria shall be followed:
    i. Any wind gust reaches or exceeds 20 miles per hour (mph) as determined by a hand-held meter;
    ii. Sustained wind speeds reach or exceed 12 mph averaged over a period of 10 minutes;
    iii. Winds produce visible emissions or create movement of dust or debris in or near the work area; or,
    iv. Winds impact the ability of engineering controls to work as designed.
3) Soil removal/disturbance operations may resume after all of the following four conditions have been met:
    i. All wind gust readings, for a period of 10 minutes, drop below 20 miles per hour as determined by hand-held instruments;
    ii. Sustained wind speeds are below 12 miles per hour averaged over a period of 10 minutes;
    iii. Winds are no longer producing visible emissions or creating movement of dust or debris in or near the removal/disturbance area; and,
    iv. Winds are not impacting the ability of engineering controls to work as designed.

4) All water used in the following procedure shall be amended water (as described in Section 6.1.3.1);

5) Excavation shall be conducted as specified in the CDOT construction documents. Prior to soil disturbance, the contractor shall adequately wet the first lift of soil to prevent visible emissions. During excavation, the contractor shall use a mister on the track hoe and/or hand-operated misters/sprayers to ensure that the soil and any suspect asbestos material are adequately wet to prevent visible emissions. Use of both is size of excavation and condition (weather and/or asbestos potential) dependent;

6) Carefully excavate layers of soil remaining by limiting the quantity of soil so that it can be adequately wetted and contained within each scoop of the backhoe. The CABI shall conduct a subsurface visual inspection for asbestos material as excavation proceeds and inspect the soil during removal by the Contractor;

7) All excavated RACS, not direct loaded into trucks or roll-offs for disposal, shall be placed on 6-mil, or greater, polyethylene sheeting. Staging (12 hours or less), stockpiling (more than 12 hours and up to 10 calendar days) and storage (exceeding 10 calendar days not to exceed 6 months) of RACS onsite (if applicable) will be in accordance with Solid Waste Regulation 5.5.7 (H)

8) During loading, the excavator or front-end loader or equivalent, moving the soils into the haul truck or roll-off shall have the sprayer bar operating to wet the material being loaded. A ground based sprayer shall also spray/wet the bucket as it is unloaded into the truck;

9) The truck, or disposal container, shall be placed on 10-mil polyethylene sheeting while being loaded so that any over-spill can be picked up. Any over-spill material shall be cleaned up before the truck is allowed to leave the loading area to prevent possible cross-contamination. Additionally, the 10-mil polyethylene sheeting in the loading area shall be decontaminated (in accordance with Section 9.1) or changed as needed to prevent possible cross-contamination. The excavator operator, the person operating the spray unit, the CABI, and any other personnel in the area immediately helping the soil operation shall be in Tyvek®, respirator, and air pumps. This requirement does not apply to haul truck drivers as long as they are directed to keep their windows rolled up and shut-off all air delivery systems (fans on air conditioning and heating systems) until they leave the area of active soil disturbance;

10) The anticipated total depth of excavation will be specified in the CDOT construction documents. If asbestos material is still present at the total planned depth of the excavation, the Contractor shall notify CDOT. Although not required by Section 5.5 Regulation, at CDOT's discretion, based on project and site specific conditions such as type of ACM(s) encountered and assumed limited vertical extent, the Contractor may continue excavating in 1 foot lifts to a depth where visible asbestos is no longer observed. If it appears that the ACM has a larger areal and vertical extent, the CABI, after

consulting with CDOT, shall then direct activities to be conducted in accordance with **Section 11** of this document;

11) If no more visible RACS is discovered at the conclusion of excavation and/or earthmoving activities, and if required and at the discretion of CDOT, soil samples for asbestos analysis shall be collected by the CABI from each excavation as follows:

    i. The CABI shall collect a separate 10-point composite soil sample from each sidewall and from the floor for every 1,250 square feet of excavation. Aliquots shall be one (1) tablespoon each but must include any locations of observed friable asbestos, after this material has been removed;

    ii. The CABI shall label and handle the sample containers using proper chain-of-custody protocol and decontaminate all non-disposable sampling equipment between samples in accordance with Section 9; and,

    iii. All samples shall be analyzed using accepted PLM methodology for asbestos bulk samples by laboratories accredited according to the provisions set forth in AQCC Regulation No. 8. All samples will be prepared by the laboratory in accordance with Solid Waste Regulation Section 5.5 Appendix 5A Analytical Requirements prior to sample analysis.

12) If at the conclusion of excavation and/or earthmoving activities, and at the request and/or discretion of CDOT, known or suspect RACS and/or ACM is to be left in place, the remaining RACS and/or ACM will be handled as described in **Section 11.0**;

13) Excavated RACS and ACM shall be placed in designated containers labeled for asbestos in accordance with the Colorado Solid Waste Regulations. The RACS and ACM shall be loaded using all necessary procedures to prevent visible emissions. These include misting/wetting during the loading process, keeping the bucket as close as possible to the interior of the container before dumping, and slow dumping to allow adequate wetting. Use of leak tight containers and other disposal requirements shall be in accordance with Section 5.5.8 of the Colorado Solid Waste Regulations (e.g., burrito wrap, single or double liner);

14) If trucks are used, soil with visible non-friable ACM, or RACS with no visible asbestos debris, shall be loaded in to single lined trucks. Soil with visible friable ACM shall be loaded into double lined trucks;

15) If the excavation will be left open overnight, access to the area must be restricted and any exposed portions of the excavation or soil piles containing known or suspect visible asbestos or RACS must be covered or otherwise stabilized; and,

16) All RACS that are stockpiled or placed in roll-offs shall be covered with 10-mil polyethylene sheeting and/or treated with a chemical stabilizing agent and inspected daily to ensure sheeting is intact.

17) It should be noted that while both covering with polyethylene sheeting and treating with a chemical stabilizing agent are acceptable options for stabilization, the chemical stabilization is preferential because of the fact that windy conditions can create problems with stabilization through the use of polyethylene sheeting (e.g. wind blowing poly. sheeting off stabilized materials, wind creating bellowing effect with poly. sheeting that may lead to asbestos fiber release, etc.)

6.3 Excavation and Earthmoving, Suspect RACS (Possible Encounter)

This section applies to soil disturbing work in areas at which RACS is suspected.

The CDPHE will be notified at least 10-days prior to any planned soil-disturbing activity in areas of suspected RACS. The HMWMD can be notified by using the Notification Form attached to this plan, and mailed to: Colorado Department of Public Health and Environment, HMWMD-B2 Attn: Brian Long, Solid Waste Compliance Assurance Unit, 4300 Cherry Creek Drive S., Denver, CO 80246-1530, or emailed to briant.long@state.co.usNotification forms are provided in Attachment 1 to this plan. **For emergency repair projects to utilities, etc, notification will be provided to CDPHE by the next business day. Note that for existing projects, where project information has already been provided to CDPHE, notification shall be provided to the established CDPHE contact, and use of the forms in Attachment 1 may not be necessary.**

The CDOT CABI must be present during all soil disturbing activities in areas where there is a reasonable suspicion that RACS may be encountered. As the excavation advances, the CABI shall inspect the bucket for asbestos debris as the soils are removed from the excavation, and if not direct loaded, in the staging area. If the CABI discovers asbestos the following procedure shall be followed:

1) The air monitoring requirements specified under Section 7.0 shall be followed;
2) The wind stoppage criteria under Section 6.2 shall be followed;
3) All water used in the following procedure shall be amended water (Section 6.1.3.1)
4) If RACS are observed, and if does not meet the requirements for Limited Quantity Unexpected Asbestos Discovery and Management (Section 6.1.3), the CABI shall closely observe the excavation and bag (or direct load) the RACS. The excavator shall start using the sprayer bar with amended water on the excavation face. Alternatively wetting may be conducted by personnel on the ground with spraying equipment;
5) If in the excavation process, a significant quantity of RACS is encountered, such that hand removal of the debris and surrounding soil is not feasible (Section 6.1.3), the excavated soils from this excavation area shall be treated as described in Section 6.2. All excavated soils shall be covered by 6-mil or greater polyethylene sheeting and/or treated with a chemical stabilizing agent, unless direct loaded or containerized. These activities can be stopped when no additional asbestos is observed within a 3 linear feet, in the

direction of excavation, from the last visible asbestos debris. These soils shall be disposed as non-friable RACS, as described in Section 10.0;

6) If RACS is observed, and not related to steam lines or other facility components which are subject to AQCC Regulation No. 8 (Section 6.3.7, below), the RACS or visible RACS shall be segregated on 10-mil polyethylene sheeting, unless direct loaded or containerized. The segregation shall continue for 3 linear feet, in the direction of excavation, after the last occurrence of RACS. As soon as friable ACM is encountered, wetting may be conducted by personnel on the ground with spraying equipment or the spray bar on the excavator shall be activated. Extra wetting support may be required by ground based personnel on the working face, as necessary to ensure that there are no visible emissions. The excavator operator, the CABI, and personnel handling the spray on the working face shall don Tyvek®, respirator, and personal air pumps for air monitoring (excluding truck drivers, as noted in Section 6.2.9). Unless direct loaded or containerized, the soils shall be placed on 6-mil or greater polyethylene sheeting, and as soon as possible tightly covered with 6-mil or greater polyethylene sheeting, and/or treated with a chemical stabilizing agent, to prevent wind dispersion of the soils. The wetting, PPE, and air monitoring shall continue until no additional asbestos is observed for 3 linear feet, in the direction of excavation, beyond the last occurrence of visible asbestos debris. The excavator bucket shall be decontaminated over the soil pile and standard excavation protocols may resume. However, if excavation equipment is driven onto RACS, more thorough decontamination, in accordance with Section 9.0, shall be conducted;

7) Removal of ACM on a facility component with asbestos quantities above the following trigger levels is subject to the notification, permit, and abatement requirements of AQCC Regulation No. 8, and shall not be conducted under this SOP:

   i. 260 linear feet on pipes,

   ii. 160 square feet on other surfaces, or,

   iii. The volume equivalent of a 55-gallon drum.

   However, removal of asbestos-containing material on a facility component, that is below the AQCC Regulation No. 8 trigger levels, and that is located on or in soil, shall be conducted under this SOP in accordance with work practices in AQCC Regulation No. 8, Part B, Section III.O. This removal is not subject to the notification or permit requirements of Air Regulation No. 8; and,

8) RACS shall be removed for disposal, or place in lined roll offs, no longer than 3 days after excavation. When loading soils with friable asbestos for disposal, the soils shall be loaded into double lined roll offs or dump trucks, or a second liner can be added to a non-friable load which already has a single liner, manifested, and disposed at a landfill permitted to accept this material. In the event that a second liner has been added, the entire load will be considered friable asbestos. The excavator or front-end loader or

equivalent, moving the soils into the haul truck/roll-off shall have the sprayer bar operating to wet the material being loaded and/or a ground based sprayer shall spray/wet the bucket as it is unloaded into the truck. The truck shall be placed on 10-mil polyethylene sheeting while being loaded so that any over-spill can be picked up. The excavator operator, the person operating the spray unit, the CABI, and any other personnel in the area immediately helping the soil operation shall be in Tyvek®, respirator, and air pumps (excluding truck drivers, as noted in Section 6.2.9). This soil shall be disposed as friable RACS, as described in Section 10.0.

6.4 RACS SPILL RESPONSE

1) Areas where RACS is spilled are RWAs until cleanup is completed.
2) Spilled material shall be cleaned up immediately and not allowed to dry out or accumulate on any surface. The CDPHE Hazardous Materials and Waste Management Division shall be notified, through the spill reporting hotline, in the event that spills of RACS cannot be cleaned up within 24 hours of spill identification.
3) Where there are breaches in ground coverings that have the potential to allow RACS or asbestos contaminated water to impact the material below the covering, a minimum of 3 inches of soil, or other matrix material, shall be removed from beneath the breached ground coverings. Visual or measured (e.g. survey) confirmation that 3 inches of soil/or other matrix material from beneath the breached covering has been removed shall be conducted. If ground coverings are placed on top of a durable surface such as concrete or asphalt, the surface shall be decontaminated using wet methods, followed by CBI inspection that all soil and debris has been removed from the surface.
4) Rinsate, runoff, or any other water that has come into contact with RACS shall be considered to be asbestos contaminated water and shall be collected and filtrated to less than 5 microns and discharged to a sanitary sewer of re-applied to RACS that will be managed under this SOP.
5) Surfaces that are contacted by asbestos contaminated water shall be managed as RACS as per 5.5.7 (J)(3) or permanently stabilized as per 5.5.7 (K) of the Solid Waste Regulations.
6) If work practices in an RWA are causing an ongoing spill outside the RWA, the work practices shall cease or be modified to prevent additional releases.

7.0 AIR MONITORING REQUIREMENTS

During the removal or disturbance of RACS, the AMS will collect personnel air monitoring samples to assist in determining the adequacy of engineering and environmental controls employed at the site. The air monitoring specialist will maintain a daily air monitoring log. Depending on the size of the work area and the type of soil being removed, air monitoring may include personnel air monitoring only, or personnel monitoring and perimeter air monitoring for large open areas. In general, personnel air monitoring only (i.e., no perimeter monitoring) shall be used when RACS disturbance will not exceed a duration of two (2) days.

Perimeter monitoring shall be used when disturbing RACS during projects over 2 days in duration. In addition, if the work area is proximate to occupied buildings or areas of public access, perimeter air monitoring may be necessary to demonstrate that no asbestos fibers have left the work area.

7.1 Personal Air Monitoring

Personal air monitoring shall be performed in accordance with all OSHA requirements during all disturbance of known and suspect asbestos in soils. In addition to OSHA requirements, for all RACS excavation activities, at least two (2) different workers or 25 percent of the workers, whichever is greater, and who are expected to have the worst-case exposure to asbestos during excavation, shall be monitored to assist in determining the adequacy of engineering and environmental controls employed at the site.

7.2 Perimeter Air Monitoring for Asbestos

Perimeter monitoring shall be performed during all excavations of RACS that exceed a duration of two (2) days. Perimeter monitoring will consist of four (4) air monitoring points located at the points of the compass. Additionally, two (2) downwind floater samples shall be collected during mechanical disturbance of RACS containing friable ACM (to be moved based on prevailing wind direction and adjacent receptors). Additional perimeter monitoring points shall be added if the active area of soil disturbance is larger than approximately 1 acre in size. As general rule of thumb, one additional monitoring point should be added for each additional 200 linear feet of the active disturbance area perimeter (approximately 1 sample per additional ¼ acre increase in area). The AMS should place downwind floating samples such that they are at least 50 feet from any other sample point.

7.3 Air Sample Analysis and Response to Detected Asbestos Fibers

All the air samples shall be analyzed for total fibers using PCM analysis by submitting to an AIHA Proficiency Analytical Testing (PAT) and NIST NVLAP accredited laboratory at the end of each work day. The two samples (or 25% of the PCM samples; whichever is greater) with the highest fiber concentrations by PCM will be analyzed by TEM for asbestos fibers. In addition,

any sample with fiber counts greater than 0.01 f/cc, detected by PCM analysis, shall be analyzed by TEM to determine if asbestos is present. Verbal results shall be made available to the Contractor and AMS by the start of the next business day or as soon as practical after the start of the next business day, and written results shall be made available on-site within 24 hours from the time the verbal result is received.

For active areas of soil disturbance greater than 1 acre, additional samples shall be analyzed by TEM at a rate of at least 25% of the total number of samples collected. The additional samples selected for TEM analysis should be those with the next highest PCM results; however, TEM analysis is not required if the PCM results are non-detect (based on fiber count). If asbestos is detected by TEM analysis, engineering controls shall be reviewed and appropriately changed.

After five (5) days of monitoring the same type of field operation with no asbestos detection by TEM analysis, the frequency of TEM analysis of the two highest samples (or 25% of the PCM samples; whichever is greater) can be reduced to once every 5 days with the remaining samples being analyzed by PCM. The samples submitted shall be either the first occurrence of: 1) high winds exceeding wind shut down criteria, or 2) visible emissions. In the absence of either the selected day for TEM analysis may be random as determined by the AMS. However, any sample with fiber counts greater than 0.01 f/cc, detected by PCM analysis, shall be analyzed by TEM to determine if asbestos is present.

If conditions or engineering controls change substantially or if there are any TEM detections of asbestos, the initial air monitoring procedures shall be repeated for three additional days or until air monitoring results demonstrate that the new or modified engineering controls are adequate.

The Contractor and AMS shall review the TEM analysis of personnel air monitoring samples with positive TEM Results. CDPHE shall be immediately notified should any air sample show any concentration of airborne asbestos fibers. In the event asbestos fibers are detected, the following shall occur:

1) Excavation shall immediately cease;
2) The source(s) of emissions identified;
3) Engineering controls will be reevaluated to ensure that additional fiber releases do not occur; and,
4) If asbestos fibers are detected in samples collected on subsequent days:
    i. All soil-disturbing activities shall immediately cease,
    ii. The source(s) of emissions shall be identified;

iii. An emission control plan, in accordance with Section 5.5.7(E)(2)(f)_of the Solid Waste Regulations shall be derived and submitted to CDOT and the CDPHE for review; and,

iv. Soil disturbance shall not continue until CDPHE provides verbal and/or written authorization to proceed.

v. If there are three (3) TEM detections on consecutive analysis events or ten (10) detections for a single project, consultation with CDPHE is required in accordance with Section 5.5.7(E)(2)(g) of the Solid Waste Regulations.

8.0 DOCUMENTATION

All asbestos discoveries, excavation, handling, and disposal shall be communicated with CDPHE from discovery through completion in addition to the normal site channels.

The CABI is responsible for documenting all asbestos inspection observations and sampling activities. **Detailed, complete, and accurate record shall be documented on all applicable Forms contained in this SOP during the field activities (Attachment 2) and shall include documentation as required in Section 5.5.7 (L) of the Colorado Solid Waste Regulation.**

The CABI/QPM shall also be responsible for maintaining the photographic log and the project field logbook. The purpose of the field logbook is to document a semi-narrative record of the field conditions, activities, and events relevant to the field program on a daily basis. Information to be documented in the logbook includes air monitoring, wind stoppage events, decontamination procedures, ACM and/or RACS handling, sample collection, and any other pertinent information not already contained on the inspection and Sampling Forms in this SOP.

9.0 EQUIPMENT AND WORKER DECONTAMINATION PROCEDURES

The purpose of this protocol is to specify decontamination procedures that must be followed when performing asbestos inspections, excavations and other soil disturbing activities.

IN GENERAL, EVERY EFFORT SHALL BE TAKEN TO AVOID DRIVING IN CORRIDORS OR AREAS THAT ARE KNOWN TO CONTAIN ASBESTOS OR HAVE THE POTENTIAL TO CONTAIN ASBESTOS.

9.1 Equipment Decontamination

To minimize decontamination requirements, areas of asbestos contaminated soil may be covered prior to vehicle access. Covering may consist of either 6 inches of clean fill (crushed concrete, gravel, soil, or similar type material) or 10-mil polyethylene sheeting. For haul trucks being loaded with RACS for offsite disposal, the truck may be driven onto 10-mil, or greater, polyethylene sheeting and loaded with care being taken to minimize spillage. After loading, all soil and debris that has spilled onto the polyethylene sheeting must be removed prior to the truck being allowed to roll forward. Removal of soil and debris (which should already be adequately wet) will be conducted with shovels, brooms, or squeegees. If necessary, the polyethylene sheeting may be replaced or hosed down, however, care should be taken to ensure that decontamination water does not leave the immediate work area, or that it is collected and filtered as described in 8) below. The polyethylene sheeting must be visually clean, or replaced, before the next haul truck enters the loading area.

In cases where vehicles or larger equipment (such as backhoes) must be used at the site to conduct subsurface excavations or earthmoving activities access is subject to the following conditions:

1) No driving is allowed on any area of known or suspect RACS during the excavation or earthmoving activities;
2) The CABI may do a limited clearance of an area to allow vehicle crossing. For areas containing friable asbestos, the area must be confirmed clean by soil sampling prior to allowing access;
3) Prior to driving in the area, the established access route must be clearly demarcated in the field using flagging, tape, stakes, signs, etc.;
4) Rubber-tired vehicles shall be used to the maximum extent feasible;
5) Vehicles entering the area shall avoid causing the release of fugitive dust. Vehicle operators shall be observant by driving in a slow, cautious manner.
6) The CABI must be in front of the vehicle to guide the vehicle from driving across any visible asbestos material. Should the CABI observe any suspect or known asbestos materials, the operator/driver shall alter course to avoid them;
7) Vehicle access routes may be required to be wetted as needed to make the ground surface damp so that fugitive dust is not generated when driven on. Determination if wetting is required is based on a case-by-case basis between the CABI and CDOT;

8) For the purposes of decontamination, the wheels of vehicles exiting the area shall be thoroughly rinsed as each vehicle exits the area determined to have asbestos present on the surface. The driver shall then drive onto a polyethylene tarp and re-rinse the wheels. A 60-mil or greater liner may be used multiple times, or 10-mil polyethylene sheeting may be used for a single decontamination event. If 10-mil polyethylene sheeting is used, care must be used to prevent it from tearing. All water must be collected, filtered with 5-micron filter, and then disposed in a sanitary sewer. Subject to CDOT site-specific approval, the rinsate may be collected and placed on a known asbestos area that will be managed under this SOP (this area must be kept adequately wet or stabilized until it is managed). The water must not run-off an asbestos area onto a non-contaminated area or toward any surface water feature. The 60-mil or greater liners may be decontaminated for reuse and one-time use 10-mil polyethylene sheeting shall be disposed as asbestos waste; and,

9) Also for the purposes of decontamination and to the extent feasible, the excavator/front end loader or equivalent shall operate on clean areas. 10-mil polyethylene sheeting or liner material can be used to drive onto contaminated areas. When moving from one location to another, the bucket that came into contact with the RACS shall be wrapped in 10-mil polyethylene sheeting to prevent spreading fibers to non-contaminated areas. When it is finished loading, the bucket shall be decontaminated over the last dump truck prior to closing the 10-mil polyethylene sheeting liner/burrito wrap. If the excavator, or other large pieces of equipment, was required to work on contaminated soil, the piece of equipment will be decontaminated as described in 8) above.

Sampling equipment, backhoe buckets, wheelbarrows, vehicles, and other equipment that comes in contact with soil known to contain, or potentially contain asbestos shall be decontaminated in accordance with water or by wet wiping between each sample, hole, or excavation to avoid potential cross-contamination, and before leaving the site. The rinsate shall be managed as stated above.

Another option to wet methods described above is to use HEPA vacuums followed by CABI inspection and verification of equipment decon before it leaves the decontamination area. All wet decon of equipment will be followed by CABI inspection and verification of equipment decontamination before it leaves the decontamination area.

9.2 Worker Decontamination

During all soil-disturbing activities in areas with friable asbestos, a fully functioning decontamination unit or trailer shall be available onsite for worker decontamination. The decontamination unit will be centrally located between the investigation areas. The decontamination unit will consist of three (3) chambers and has fully operational hot and cold running water for the shower.

At the beginning of each day, or each time the RWA is to be entered, workers that will be in the area of active RACS disturbance will don disposable protective suites (Tyvek®), disposable gloves and disposable boot covers (excluding truck drivers, as noted in Section 6.2.9). Worker decontamination shall be conducted each time a worker leaves the RWA. For most projects, worker decontamination may consist of removal of Tyvek® suites, gloves and boot covers, which should then be containerized and disposed as asbestos waste. Any non-disposable personnel items must be decontaminated with water or by wet wiping. Rinsate from the boot wash station shall be collected, filtered to less than 5 microns (or applicable local requirement) and discharged to a sanitary sewer or other CDPHE approved disposal facility, or re-applied to RACS that will be managed under this SOP (this area must be kept adequately wet or stabilized until it is managed).

The decontamination unit, as indicated in the Contractors Health and Safety Plan, may be utilized by the workers each time they exit the work area. All contaminated disposable personnel protective equipment shall be containerized and disposed as asbestos waste. Water from the decontamination unit will be filtered to 5 micron and disposed as described above.

10.0 Disposal

Disposal of RACS shall be conducted in accordance with the following requirements, in accordance with Section 5.5.8 of the Colorado Solid Waste Regulations:

1) RACS containing visible friable asbestos will be disposed of in a leak tight container as friable asbestos waste in accordance with the requirements of Section 5.3 of the Solid Waste Regulations. Documentation stating that the asbestos-contaminated soil originating from the site shall not be used as daily cover or sold as clean fill accompany each load of asbestos-contaminated soil removed from the site;
2) RACS containing only visible non-friable asbestos that has not been rendered friable will be packaged in a leak tight container and disposed of as non-friable asbestos in accordance with Section 5.2 of the Solid Waste Regulations. Documentation stating that the asbestos-contaminated soil originating from the site shall not be used as daily cover or sold as clean fill accompany each load of asbestos-contaminated soil removed from the site;
3) RACS containing no visible asbestos shall be packaged in a leak tight container and disposed as non-friable asbestos waste, as described in Section 5.2 of the Solid Waste Regulations. Documentation stating that the asbestos-contaminated soil originating from the site shall not be used as daily cover or sold as clean fill accompany each load of asbestos-contaminated soil removed from the site;
4) Soils that are not asbestos-contaminated, based on analysis showing no detectable amounts of asbestos, may be replaced into the disturbed area as needed, used as fill, or disposed of as solid waste; and,
5) The use of soils containing solid waste may be approved for reuse onsite or offsite if the soil and solid waste meet the suitability requirements of Section 5.5.8 of the Regulations and if the constituents of the solid waste are acceptable. The receipt of a beneficial reuse determination from the Materials Management Unit of the Division may also be required depending on the constituents of the solid waste. If the solid waste consists of RACS an environmental covenant may also be required prior to reuse.

11.0 Remaining RACS

In the event that RACS is left in place following the conclusion of excavation or earthmoving activities, the Contractor shall:

1) Document the condition and location of remaining RACS. Documentation will be at the discretion of CDOT, but may include GPS, land survey, photographic documentation, etc.
2) The remaining RACS will be treated with a soil stabilizer;
3) The remaining RACS will be covered with an appropriate engineered fabric; and,
4) The remaining RACS will be covered with geofabric, followed by 18-inches of fill suitable for unrestricted use and vegetation, or cover RACS with geofabric followed by six (6) inches of clean fill and concrete or asphalt; or, cover RACS with geofabric followed by clean fill to grade or six (6) inches, whichever is greater, for vertical excavation faces or trenches; or, alternate cover designs as approved by the CDPHE and CDOT.

The specific soil stabilizer and engineered fabric used will be dependent on site-specific information, and will be approved of by CDOT prior to application.

As noted previously (Section 6.3), the excavation and removal of ACM on a facility component below the AQCC Regulation No. 8 trigger levels is permitted under this SOP. However, in those instances when ACM on a facility component is left in place following partial excavation and removal, the Contractor shall:

1) Document the condition and location of the facility component and remaining ACM. Documentation will be at the discretion of CDOT, but may include ACM type, GPS, land survey, and photographic documentation.

12.0 Reporting

At the request and discretion of CDOT, Contractor shall periodically prepare a report documenting the RACS and/or ACM work completed. The frequency of the reporting shall be determined by CDOT. The report may include the following:

1) Description of known, suspect or unexpected discovery of RACS;
2) Description of field operations;
3) Containment logs (where appropriate);
4) Air monitoring procedures and laboratory results;

5) Description of RACS work completed, including inspection procedures, sampling procedures and analytical results if any;
6) Disposal manifests;
7) Description of the condition and location of remaining RACS, including GPS, land survey, photographic documentation, (see Section 11.0);
8) Photographs, if any, taken prior to, during and/or after RACS work completed; and,
9) Accreditation and Certification documentation for activities covered under this SOP.

ATTACHMENT 1

CDPHE ASBESTOS-CONTAMINTED SOIL NOTIFICATION FORMS

COLORADO
Department of Public Health & Environment
Dedicated to protecting and improving the health and environment of the people of Colorado

NOTIFICATION OF REGULATED ASBESTOS CONTAMINATED SOIL (RACS) DISTURBANCE

A map, figure, or drawing, to a recognizable engineering scale, depicting the project area(s) must be submitted with this form.
The form, plan (if applicable), and depiction of the project area, can be emailed to: briant.long@state.co.us; or, mailed to: Colorado Department of Public Health and Environment, HMWMD-B2 Attn: Brian Long, Solid Waste Compliance Assurance Unit, see address below.

Date and time reported:	
☐ Planned management Start date: Estimated duration:	☐ Unexpected discovery (submit within 24 hours of discovery) Discovery date and time: Estimated duration:
Description of planned soil-disturbing activities:	Description of activities resulting in RACS discovery/disturbance:
Description of any access and/or emission control measures already implemented at the site:	Description of type and quantity of RACS discovered/disturbance:
☐ This is an EMERGENCY management event (submit this form within 24 hours of RACS discovery, and comply with the Minimum Standards to the extent possible during initial management, and fully comply within 48 hours) Detail the nature of the emergency (e.g., repair to an active utility line):	

Check the box to indicate which management approach will be utilized on this project:

☐ Project Specific RACS Mgmt. Plan Submit PSRMP for Division review and approval with this form at least 10 working days prior to commencing RACS disturbing activities. RACS disturbance shall not commence until the PSRMP is approved. However, the standard requirements from Section 5.5.7 of the Solid Waste Regulation may be used in the interim after the required notice.	☐ Standard Operating Procedures Has the Division approved SOPs for this project? ☐ Yes, include the name of the SOP here: Notification shall be submitted to the Division prior to commencing RACS disturbing activities. ☐ No, submit SOPs for Division review and approval with this form at least 30 calendar days prior to commencing RACS disturbing activities.	☐ Remediation Plan Submit remediation plan for Division review and approval at least 45 calendar days prior to commencing RACS disturbing activities. Remediation shall not commence prior to plan approval.
☐ Standard Requirements The standard requirements of RACS management are found in Section 5.5.7 of the Solid Waste Regulations. Notification shall be submitted to the Division prior to commencing RACS disturbing activities.		☐ Risk Based Approach Submit a site-specific risk assessment work plan for Division review and approval with this form prior to commencing RACS disturbing activities. RACS disturbance shall not commence until the plan is approved.

Please indicate which program this project will take place under: ☐ Solid Waste (general) / ☐ Voluntary Cleanup Program (VCUP) / ☐ Hazardous Waste Corrective Action (RCRA) / ☐ Federal Facilities or CERCLA / ☐ Don't Know

Contact person for entity performing soil-disturbing activity:		
Organization, company or agency:		
Email:	Phone:	
Name of property owner/operator:		
Owner/operator contact (if different):		
Email:	Phone:	Ext:
Location of property: (Street address or other location description)	Street Address:	
	County: / City:	Zip:
General site description:		

Received by:_____ Date:_____

ATTACHMENT 2

CDOT FIELD DOCUMENTATION FORMS

CDOT FIELD DOCUMENT FORM – UNEXPECTED ASBESTOS DISCOVERY

Date:	**Time of Discovery:**
Contractor that Encountered Asbestos	
Name: Company: Address: Phone Number:	
Location of Discovery: (Address, Survey Marker, Mile Marker, etc.)	**Sketch of Area with Asbestos Location Depicted**
General Description of Area:	
Field Activity that Caused the Encounter:	
Type(s) of Material Identified:	

Samples Collected ID:	Time:	Date:	Description:	Results:

Description of SOP Implementation Procedures:

Phil Kangas of CDOT Hazardous Waste Unit, Asbestos Program Project Manager must be notified by phone immediately. This form must be submitted and received by Mr. Kangas within 24 hrs. of unexpected discovery.
Office: 303-512-5519 Cell: 303-325-6123 Fax: 303-512-5550 Email: phillip.kangas@.state.co.us

Appendix B USEPA Toxicity Characteristic Maximum Concentration of Contaminants

ED_002842A_00000589-00157

§ 261.24 Toxicity characteristic.

(a) A solid waste exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW–846, as incorporated by reference in § 260.11 of this chapter, the extract from a representative sample of the waste contains any of the contaminants listed in table 1 at the concentration equal to or greater than the respective value given in that table. Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using the methodology outlined in Method 1311, is considered to be the extract for the purpose of this section.

(b) A solid waste that exhibits the characteristic of toxicity has the EPA Hazardous Waste Number specified in Table I which corresponds to the toxic contaminant causing it to be hazardous.

TABLE 1—MAXIMUM CONCENTRATION OF CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC
2

Contaminant	CAS No.	Regulatory Level (mg/L)
D004 Arsenic	7440–38–2	5.0
D005 Barium	7440–39–3	100.0
D018 Benzene	71–43–2	0.5
D006 Cadmium	7440–43–9	1.0
D019 Carbon tetrachloride	56–23–5	0.5
D020 Chlordane	57–74–9	0.03
D021 Chlorobenzene	108–90–7	100.0
D022 Chloroform	67–66–3	6.0
D007 Chromium	7440–47–3	5.0
D023 o-Cresol	95–48–7 4	200.0
D024 m-Cresol	108–39–4	[4] 200.0
D025 p-Cresol	106–44–5	[4] 200.0
D026 Cresol		[4] 200.0
D016 2,4-D	94–75–7	10.0
D027 1,4-Dichlorobenzene	106–46–7	7.5
D028 1,2-Dichloroethane	107–06–2	0.5
D029 1,1-Dichloroethylene	75–35–4	0.7
D030 2,4-Dinitrotoluene	121–14–2	[3] 0.13
D012 Endrin	72–20–8	0.02
D031 Heptachlor (and its epoxide)	76–44–8	0.008
D032 Hexachlorobenzene	118–74–1	[3] 0.13
D033 Hexachlorobutadiene	87–68–3	0.5
D034 Hexachloroethane	67–72–1	3.0
D008 Lead	7439–92–1	5.0
D013 Lindane	58–89–9	0.4

D009 Mercury	7439–97–6	0.2
D014 Methoxychlor	72–43–5	10.0
D035 Methyl ethyl ketone	78–93–3	200.0
D036 Nitrobenzene	98–95–3	2.0
D037 Pentrachlorophenol	87–86–5	100.0
D038 Pyridine	110–86–1	[3] 5.0
D010 Selenium	7782–49–2	1.0
D011 Silver	7440–22–4	5.0
D039 Tetrachloroethylene	127–18–4	0.7
D015 Toxaphene	8001–35–2	0.5
D040 Trichloroethylene	79–01–6	0.5
D041 2,4,5-Trichlorophenol	95–95–4	400.0
D042 2,4,6-Trichlorophenol	88–06–2	2.0
D017 2,4,5-TP (Silvex)	93–72–1	1.0
D043 Vinyl chloride	75–01–4	0.2

[1] Hazardous waste number.
[2] Chemical abstracts service number.
[3] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
[4] If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.
[55 FR 11862, Mar. 29, 1990, as amended at 55 FR 22684, June 1, 1990; 55 FR 26987, June 29, 1990; 58 FR 46049, Aug. 31, 1993]

Green Font denotes DNAPL chemical

Appendix C USEPA Regional Screening Levels

Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				1.2E-03	O					1	0.1		Acephate	30560-19-1	7.6E+01	n	9.8E+02	n					2.4E+01	n		5.3E-03	n	
		2.2E-06	I			9.0E-03	I	V		1		1.1E+05	Acetaldehyde	75-07-0	1.1E+01	c**	4.9E+01	c**	1.3E+00	c**	5.6E+00	c**	2.6E+00	c**		5.2E-04	c*	
				2.0E-02	I					1	0.1		Acetochlor	34256-82-1	1.3E+03	n	1.6E+04	n					3.5E+02	n		2.8E-01	n	
				9.0E-01	I	3.1E+01	A	V		1		1.1E+05	Acetone	67-64-1	6.1E+04	n	6.7E+05	nms	3.2E+04	n	1.4E+05	n	1.4E+04	n		2.9E+00	n	
						2.0E-03	X			1	0.1		Acetone Cyanohydrin	75-86-5	2.8E+06	nm	1.2E+07	nm	2.1E+00	n	8.8E+00	n						
						6.0E-02	I	V		1		1.3E+05	Acetonitrile	75-05-8	8.1E+02	n	3.4E+03	n	6.3E+01	n	2.6E+02	n	1.3E+02	n		2.6E-02	n	
				1.0E-01	I			V		1		2.5E+03	Acetophenone	98-86-2	7.8E+03	ns	1.2E+05	nms					1.9E+03	n		5.9E-01	n	
3.8E+00	C	1.3E-03	C							1	0.1		Acetylaminofluorene, 2-	53-96-3	1.4E-01	c	6.0E-01	c	2.2E-03	c	9.4E-03	c	1.6E-02	c		7.2E-05	c	
				5.0E-04	I	2.0E-05	I	V		1		2.3E+04	Acrolein	107-02-8	1.4E-01	n	6.0E-01	n	2.1E-02	n	8.8E-02	n	4.2E-02	n		8.4E-06	n	
5.0E-01	I	1.0E-04	I	2.0E-03	I	6.0E-03	I		M	1	0.1		Acrylamide	79-06-1	2.4E-01	c	4.6E+00	c	1.0E-02	c	1.2E-01	c	5.0E-02	c		1.1E-05	c	
				5.0E-01	I	1.0E-03	I	V		1		1.1E+05	Acrylic Acid	79-10-7	9.9E+01	n	4.2E+02	n	1.0E+00	n	4.4E+00	n	2.1E+00	n		4.2E-04	n	
5.4E-01	I	6.8E-05	I	4.0E-02	A	2.0E-03	I	V		1		1.1E+04	Acrylonitrile	107-13-1	2.5E-01	c*	1.1E+00	c*	4.1E-02	c*	1.8E-01	c*	5.2E-02	c*		1.1E-05	c*	
						6.0E-03	P			1	0.1		Adiponitrile	111-69-3	8.5E+06	nm	3.6E+07	nm	6.3E+00	n	2.6E+01	n						
5.6E-02	C			1.0E-02	I					1	0.1		Alachlor	15972-60-8	9.7E+00	c*	4.1E+01	c					1.1E+00	c	2.0E+00	8.7E-04	c	1.6E-03
				1.0E-03	I					1	0.1		Aldicarb	116-06-3	6.3E+01	n	8.2E+02	n					2.0E+01	n	3.0E+00	4.9E-03	n	7.5E-04
				1.0E-03	I					1	0.1		Aldicarb Sulfone	1646-88-4	6.3E+01	n	8.2E+02	n					2.0E+01	n	2.0E+00	4.4E-03	n	4.4E-04
										1	0.1		Aldicarb sulfoxide	1646-87-3											4.0E+00			8.8E-04
1.7E+01	I	4.9E-03	I	3.0E-05	I			V		1			Aldrin	309-00-2	3.9E-02	c*	1.8E-01	c	5.7E-04	c	2.5E-03	c	9.2E-04	c		1.5E-04	c	
				5.0E-03	I	1.0E-04	X	V		1		1.1E+05	Allyl Alcohol	107-18-6	3.5E+00	n	1.5E+01	n	1.0E-01	n	4.4E-01	n	2.1E-01	n		4.2E-05	n	
2.1E-02	C	6.0E-06	C			1.0E-03	I	V		1		1.4E+03	Allyl Chloride	107-05-1	7.2E-01	c**	3.2E+00	c**	4.7E-01	c**	2.0E+00	c**	7.3E-01	c**		2.3E-04	c**	
				1.0E+00	P	5.0E-03	P			1			Aluminum	7429-90-5	7.7E+04	n	1.1E+06	nm	5.2E+00	n	2.2E+01	n	2.0E+04	n		3.0E+04	n	
				4.0E-04	I					1			Aluminum Phosphide	20859-73-8	3.1E+01	n	4.7E+02	n					8.0E+00	n			n	
				9.0E-03	I					1	0.1		Ametryn	834-12-8	5.7E+02	n	7.4E+03	n					1.5E+02	n		1.6E-01	n	
2.1E+01	C	6.0E-03	C							1	0.1		Aminobiphenyl, 4-	92-67-1	2.6E-02	c	1.1E-01	c	4.7E-04	c	2.0E-03	c	3.0E-03	c		1.5E-05	c	
				8.0E-02	P					1	0.1		Aminophenol, m-	591-27-5	5.1E+03	n	6.6E+04	n					1.6E+03	n		6.1E-01	n	
				4.0E-03	X					1	0.1		Aminophenol, o-	95-55-6	2.5E+02	n	3.3E+03	n					7.9E+01	n		3.0E-02	n	
				2.0E-02	P					1	0.1		Aminophenol, p-	123-30-8	1.3E+03	n	1.6E+04	n					4.0E+02	n		1.5E-01	n	
				2.5E-03	I					1	0.1		Amitraz	33089-61-1	1.6E+02	n	2.1E+03	n					8.2E+00	n		4.2E+00	n	
						5.0E-01	I	V		1			Ammonia	7664-41-7					5.2E+02	n	2.2E+03	n						
				2.0E-01	I					1			Ammonium Sulfamate	7773-06-0	1.6E+04	n	2.3E+05	nm					4.0E+03	n			n	
						3.0E-03	X	V		1		1.4E+04	Amyl Acetate, sec-	75-85-4	8.2E+01	n	3.4E+02	n	3.1E+00	n	1.3E+01	n	6.3E+00	n		1.3E-03	n	
5.7E-03	I	1.6E-06	C	7.0E-03	P	1.0E-03	I			1	0.1		Aniline	62-53-3	8.5E+01	c**	4.0E+02	c*	1.0E+00	n	4.4E+00	n	1.3E+01	c*		4.6E-03	c*	
4.0E-02	P			2.0E-03	X					1	0.1		Anthraquinone, 9,10-	84-65-1	1.4E+01	c**	5.7E+01	c*					1.4E+00	c*		1.4E-02	c*	
				4.0E-04	I					0.15			Antimony (metallic)	7440-36-0	3.1E+01	n	4.7E+02	n					7.8E+00	n	6.0E+00	3.5E-01	n	2.7E-01
				5.0E-04	H					0.15			Antimony Pentoxide	1314-60-9	3.9E+01	n	5.8E+02	n					9.7E+00	n			n	
				4.0E-04	H					0.15			Antimony Tetroxide	1332-81-6	3.1E+01	n	4.7E+02	n					7.8E+00	n			n	
						2.0E-04	I			0.15			Antimony Trioxide	1309-64-4	2.8E+05	nm	1.2E+06	nm	2.1E-01	n	8.8E-01	n						
1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C			1	0.03		Arsenic, Inorganic	7440-38-2	8.8E-01	c*R	3.0E+00	cR	6.5E-04	c*	2.9E-03	c*	5.2E-02	c	1.0E+01	1.5E-03	c	2.9E-01
				3.5E-06	C	5.0E-05	I			1			Arsine	7784-42-1	2.7E-01	n	4.1E+00	n	5.2E-02	n	2.2E-01	n	7.0E-02	n			n	
				3.6E-02	O					1	0.1		Asulam	3337-71-1	2.3E+03	n	3.0E+04	n					7.2E+02	n		1.8E-01	n	
2.3E-01	C			3.5E-02	I					1	0.1		Atrazine	1912-24-9	2.4E+00	c	1.0E+01	c					3.0E-01	c	3.0E+00	2.0E-04	c	1.9E-03
8.8E-01	C	2.5E-04	C							1	0.1		Auramine	492-80-8	6.2E-01	c	2.6E+00	c	1.1E-02	c	4.9E-02	c	6.7E-02	c		6.1E-04	c	
				4.0E-04	I					1	0.1		Avermectin B1	65195-55-3	2.5E+01	n	3.3E+02	n					8.0E+00	n		1.4E+01	n	
				3.0E-03	A	1.0E-02	A			1	0.1		Azinphos-methyl	86-50-0	1.9E+02	n	2.5E+03	n	1.0E+01	n	4.4E+01	n	5.6E+01	n		1.7E-02	n	
1.1E-01	I	3.1E-05	I					V		1			Azobenzene	103-33-3	5.6E+00	c	2.6E+01	c	9.1E-02	c	4.0E-01	c	1.2E-01	c		5.3E-04	c	
				1.0E+00	P	7.0E-06	P			1	0.1		Azodicarbonamide	123-77-3	8.6E+03	n	4.0E+04	n	7.3E-03	n	3.1E-02	n	2.0E+04	n		6.8E+00	n	
				2.0E-01	I	5.0E-04	H			0.07			Barium	7440-39-3	1.5E+04	n	2.2E+05	nm	5.2E-01	n	2.2E+00	n	3.8E+03	n	2.0E+03	1.6E+02	n	8.2E+01
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Barium Chromate	10294-40-3	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
				5.0E-03	O			V		1			Benfluralin	1861-40-1	3.9E+02	n	5.8E+03	n					2.8E+01	n		9.4E-01	n	
				5.0E-02	I					1	0.1		Benomyl	17804-35-2	3.2E+03	n	4.1E+04	n					9.7E+02	n		8.5E-01	n	
				2.0E-01	I					1	0.1		Bensulfuron-methyl	83055-99-6	1.3E+04	n	1.6E+05	nm					3.9E+03	n		1.0E+00	n	
				3.0E-02	I					1	0.1		Bentazon	25057-89-0	1.9E+03	n	2.5E+04	n					5.7E+02	n		1.2E-01	n	
4.0E-03	P			1.0E-01	I			V		1		1.2E+03	Benzaldehyde	100-52-7	1.7E+02	c*	8.2E+02	c					1.9E+01	c		4.1E-03	c	
5.5E-02	I	7.8E-06	I	4.0E-03	I	3.0E-02	I	V		1		1.8E+03	Benzene	71-43-2	1.2E+00	c*	5.1E+00	c*	3.6E-01	c*	1.6E+00	c*	4.6E-01	c*	5.0E+00	2.3E-04	c*	2.9E-03
1.0E-01	X			3.0E-04	X					1	0.1		Benzenediamine-2-methyl sulfate, 1,4-	6369-59-1	5.4E+00	c**	2.3E+01	c*					7.8E-01	c**		2.2E-04	c*	
				1.0E-03	P			V		1		1.3E+03	Benzenethiol	108-98-5	7.8E+01	n	1.2E+03	n					1.7E+01	n		1.1E-02	n	
2.3E+02	I	6.7E-02	I	3.0E-03	I				M	1	0.1		Benzidine	92-87-5	5.3E-04	c	1.0E-02	c	1.5E-05	c	1.8E-04	c	1.1E-04	c		2.8E-07	c	
				4.0E+00	I					1	0.1		Benzoic Acid	65-85-0	2.5E+05	nm	3.3E+06	nm					7.5E+04	n		1.9E+01	n	
1.3E+01	I							V		1		3.2E+02	Benzotrichloride	98-07-7	5.3E-02	c	2.5E-01	c					3.0E-03	c		6.6E-08	c	
				1.0E-01	P					1	0.1		Benzyl Alcohol	100-51-6	6.3E+03	n	8.2E+04	n					2.0E+03	n		4.6E-01	n	
1.7E-01	I	4.9E-05	C	2.0E-03	P	1.0E-03	P	V		1		1.5E+03	Benzyl Chloride	100-44-7	1.1E+00	c*	4.8E+00	c*	5.7E-02	c*	2.5E-01	c*	8.9E-02	c*		9.8E-05	c*	
		2.4E-03	I	2.0E-03	I	2.0E-05	I			0.007			Beryllium and compounds	7440-41-7	1.6E+02	n	2.3E+03	n	1.2E-03	c*	5.1E-03	c*	2.5E+01	n	4.0E+00	1.9E+01	n	3.2E+00
				9.0E-03	P					1	0.1		Bifenox	42576-02-3	5.7E+02	n	7.4E+03	n					1.0E+02	n		7.6E-01	n	
				1.5E-02	I					1	0.1		Biphenthrin	82657-04-3	9.5E+02	n	1.2E+04	n					3.0E+02	n		1.4E+03	n	
8.0E-03	I			5.0E-01	I	4.0E-04	X	V		1			Biphenyl, 1,1'-	92-52-4	4.7E+01	n	2.0E+02	n	4.2E-01	n	1.8E+00	n	8.3E-01	n		8.7E-03	n	
				4.0E-02	I			V		1		1.0E+03	Bis(2-chloro-1-methylethyl) ether	108-60-1	3.1E+03	ns	4.7E+04	ns					7.1E+02	n		2.6E-01	n	
				3.0E-03	P					1	0.1		Bis(2-chloroethoxy)methane	111-91-1	1.9E+02	n	2.5E+03	n					5.9E+01	n		1.3E-02	n	
1.1E+00	I	3.3E-04	I					V		1		5.1E+03	Bis(2-chloroethyl)ether	111-44-4	2.3E-01	c	1.0E+00	c	8.5E-03	c	3.7E-02	c	1.4E-02	c		3.6E-06	c	
2.2E+02	I	6.2E-02	I					V		1		4.2E+03	Bis(chloromethyl)ether	542-88-1	8.3E-05	c	3.6E-04	c	4.5E-05	c	2.0E-04	c	7.2E-05	c		1.7E-08	c	
				5.0E-02	I					1	0.1		Bisphenol A	80-05-7	3.2E+03	n	4.1E+04	n					7.7E+02	n		5.8E+01	n	
				2.0E-01	I	2.0E-02	H			1			Boron And Borates Only	7440-42-8	1.6E+04	n	2.3E+05	nm	2.1E+01	n	8.8E+01	n	4.0E+03	n		1.3E+01	n	
				2.0E+00	P	2.0E-02	P	V		1			Boron Trichloride	10294-34-5	1.6E+05	nm	2.3E+06	nm	2.1E+01	n	8.8E+01	n	4.2E+01	n			n	
				4.0E-02	C	1.3E-02	C	V		1			Boron Trifluoride	7637-07-2	3.1E+03	n	4.7E+04	n	1.4E+01	n	5.7E+01	n	2.6E+01	n			n	
7.0E-01	I			4.0E-03	I					1			Bromate	15541-45-4	9.9E-01	c	4.7E+00	c					1.1E-01	c	1.0E+01	8.5E-04	c	7.7E-02
2.0E+00	X	6.0E-04	X					V		1		2.4E+03	Bromo-2-chloroethane, 1-	107-04-0	2.6E-02	c	1.1E-01	c	4.7E-03	c	2.0E-02	c	7.4E-03	c		2.1E-06	c	
				8.0E-03	I	6.0E-02	I	V		1		6.8E+02	Bromobenzene	108-86-1	2.9E+02	n	1.8E+03	ns	6.3E+01	n	2.6E+02	n	6.2E+01	n		4.2E-02	n	

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PRPTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
						4.0E-02	X	V		1		4.0E+03	Bromochloromethane	74-97-5	1.5E+02	n	6.3E+02	n	4.2E+01	n	1.8E+02	n	8.3E+01	n		2.1E-02	n	
6.2E-02	I	3.7E-05	C	2.0E-02	I			V		1		9.3E+02	Bromodichloromethane	75-27-4	2.9E-01	c	1.3E+00	c	7.6E-02	c	3.3E-01	c	1.3E-01	c	8.0E+01(F)	3.6E-05	c	2.2E-02
7.9E-03	I	1.1E-06	I	2.0E-02	I			V		1		9.2E+02	Bromoform	75-25-2	1.9E+01	c*	8.6E+01	c	2.6E+00	c	1.1E+01	c	3.3E+00	c	8.0E+01(F)	8.7E-04	c	2.1E-02
				1.4E-03	I	5.0E-03	I	V		1		3.6E+03	Bromomethane	74-83-9	6.8E+00	n	3.0E+01	n	5.2E+00	n	2.2E+01	n	7.5E+00	n		1.9E-03	n	
				5.0E-03	H			V		1			Bromophos	2104-96-3	3.9E+02	n	5.8E+03	n					3.5E+01	n		1.5E-01	n	
1.0E-01	O			1.5E-02	O					1	0.1		Bromoxynil	1689-84-5	5.3E+00	c	2.2E+01	c					6.1E-01	c		5.2E-04	c	
				1.5E-02	O			V		1			Bromoxynil Octanoate	1689-99-2	1.2E+03	n	1.8E+04	n					1.0E+02	n		5.0E-01	n	
3.4E+00	C	3.0E-05	I			2.0E-03	I	V		1		6.7E+02	Butadiene, 1,3-	106-99-0	5.8E-02	c*	2.6E-01	c*	9.4E-02	c*	4.1E-01	c*	1.8E-02	c		9.0E-06	c	
				3.0E-02	O					1	0.1		Butanoic acid, 4-(2,4-dichlorophenoxy)-	94-82-6	1.9E+03	n	2.5E+04	n					4.5E+02	n		4.3E-01	n	
				1.0E-01	I			V		1		7.6E+03	Butanol, N-	71-36-3	7.8E+03	ns	1.2E+05	nms					2.0E+03	n		4.1E-01	n	
				2.0E+00	P	3.0E+01	P	V		1		2.1E+04	Butyl alcohol, sec-	78-92-2	1.3E+05	nms	1.5E+06	nms	3.1E+04	n	1.3E+05	n	2.4E+04	n		5.0E+00	n	
				5.0E-02	I			V		1			Butylate	2008-41-5	3.9E+03	n	5.8E+04	n					4.6E+02	n		4.5E-01	n	
2.0E-04	C	5.7E-08	C							1	0.1		Butylated hydroxyanisole	25013-16-5	2.7E+03	c	1.1E+04	c	4.9E+01	c	2.2E+02	c	1.5E+02	c		2.9E-01	c	
3.6E-03	P			3.0E-01	P					1	0.1		Butylated hydroxytoluene	128-37-0	1.5E+02	c	6.4E+02	c					3.4E+00	c		1.0E-01	c	
				5.0E-02	P			V		1		1.1E+02	Butylbenzene, n-	104-51-8	3.9E+03	ns	5.8E+04	ns					1.0E+03	n		3.2E+00	n	
				1.0E-01	X			V		1		1.5E+02	Butylbenzene, sec-	135-98-8	7.8E+03	ns	1.2E+05	nms					2.0E+03	n		5.9E+00	n	
				1.0E-01	X			V		1		1.8E+02	Butylbenzene, tert-	98-06-6	7.8E+03	ns	1.2E+05	nms					6.9E+02	n		1.6E+00	n	
				2.0E-02	A					1	0.1		Cacodylic Acid	75-60-5	1.3E+03	n	1.6E+04	n					4.0E+02	n		1.1E-01	n	
		1.8E-03	I	1.0E-03	I	1.0E-05	A			0.025	0.001		Cadmium (Diet)	7440-43-9	7.1E+01	n	9.8E+02	n										
		1.8E-03	I	5.0E-04	I	1.0E-05	A			0.05	0.001		Cadmium (Water)	7440-43-9					1.6E-03	c**	6.8E-03	c**	9.2E+00	n	5.0E+00	6.9E-01	n	3.8E-01
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Calcium Chromate	13765-19-0	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
				5.0E-01	I	2.2E-03	C			1	0.1		Caprolactam	105-60-2	3.1E+04	n	4.0E+05	nm	2.3E+00	n	9.6E+00	n	9.9E+03	n		2.9E+00	n	
1.5E-01	C	4.3E-05	C	2.0E-03	I					1	0.1		Captafol	2425-06-1	3.6E+00	c*	1.5E+01	c	6.5E-02	c	2.9E-01	c	4.0E-01	c*		7.1E-04	c*	
2.3E-03	C	6.6E-07	C	1.3E-01	I					1	0.1		Captan	133-06-2	2.4E+02	c*	1.0E+03	c	4.3E+00	c	1.9E+01	c	3.1E+01	c*		2.2E-02	c*	
				1.0E-01	I					1	0.1		Carbaryl	63-25-2	6.3E+03	n	8.2E+04	n					1.8E+03	n		1.7E+00	n	
				5.0E-03	I					1	0.1		Carbofuran	1563-66-2	3.2E+02	n	4.1E+03	n					9.4E+01	n	4.0E+01	3.7E-02	n	1.0E-02
				1.0E-01	I	7.0E-01	I	V		1		7.4E+02	Carbon Disulfide	75-15-0	7.7E+02	ns	3.5E+03	ns	7.3E+02	n	3.1E+03	n	8.1E+02	n		2.4E-01	n	
7.0E-02	I	6.0E-06	I	4.0E-03	I	1.0E-01	I	V		1		4.6E+02	Carbon Tetrachloride	56-23-5	8.5E-01	c	2.9E+00	c	4.7E-01	c	2.0E+00	c	4.6E-01	c	5.0E+00	1.8E-04	c	1.9E-03
						1.0E-01	P	V		1		5.9E+03	Carbonyl Sulfide	463-58-1	6.7E+01	n	2.8E+02	n	1.0E+02	n	4.4E+02	n	2.1E+02	n		5.1E-01	n	
				1.0E-02	I					1	0.1		Carbosulfan	55285-14-8	6.3E+02	n	8.2E+03	n					5.1E+01	n		1.2E+00	n	
				1.0E-01	I					1	0.1		Carboxin	5234-68-4	6.3E+03	n	8.2E+04	n					1.9E+03	n		1.0E+00	n	
						9.0E-04	I			1			Ceric oxide	1306-38-3	1.3E+06	nm	5.4E+06	nm	9.4E-01	n	3.9E+00	n						
				1.0E-01	I			V		1			Chloral Hydrate	302-17-0	7.8E+03	n	1.2E+05	nm					2.0E+03	n		4.0E-01	n	
				1.5E-02	I					1	0.1		Chlorambucil	133-90-4	9.5E+02	n	1.2E+04	n					2.9E+02	n		7.0E-02	n	
4.0E-01	H									1	0.1		Chloramben	118-75-2	1.3E+00	c	5.7E+00	c					1.8E-01	c		1.5E-04	c	
3.5E-01	I	1.0E-04	I	5.0E-04	I	7.0E-04	I	V		1	0.04		Chlordane	12789-03-6	1.7E+00	c*	7.7E+00	c*	2.8E-02	c*	1.2E-01	c*	2.0E-02	c*	2.0E+00	2.7E-03	c*	2.7E-01
1.0E+01	I	4.6E-03	C	3.0E-04	I					1	0.1		Chlordecone (Kepone)	143-50-0	5.4E-02	c	2.3E-01	c	6.1E-04	c	2.7E-03	c	3.5E-03	c		1.2E-04	c	
				7.0E-04	A					1	0.1		Chlorfenvinphos	470-90-6	4.4E+01	n	5.7E+02	n					1.1E+01	n		3.1E-02	n	
				9.0E-02	O					1	0.1		Chlorimuron, Ethyl	90982-32-4	5.7E+03	n	7.4E+04	n					1.8E+03	n		8.0E-01	n	
				1.0E-01	I	1.5E-04	A	V		1		2.8E+03	Chlorine	7782-50-5	1.8E-01	n	7.8E-01	n	1.5E-01	n	6.4E-01	n	3.0E-01	n		1.4E-04	n	
				3.0E-02	I	2.0E-04	I	V		1			Chlorine Dioxide	10049-04-4	2.3E+03	n	3.4E+04	n	2.1E-01	n	8.8E-01	n	4.2E-01	n			n	
				3.0E-02	I					1			Chlorite (Sodium Salt)	7758-19-2	2.3E+03	n	3.5E+04	n					6.0E+02	n	1.0E+03		n	
						5.0E+01	I	V		1		1.2E+03	Chloro-1, 1-difluoroethane, 1-	75-68-3	5.4E+04	ns	2.3E+05	nms	5.2E+04	n	2.2E+05	n	1.0E+05	n		5.2E+01	n	
		3.0E-04	I	2.0E-02	H	2.0E-02	I	V		1		7.9E+02	Chloro 1, 3 butadiene, 2-	126-99-8	1.0E-02	c	4.4E-02	c	9.4E-03	c	4.1E-02	c	1.9E-02	c		9.8E-06	c	
4.6E-01	H									1	0.1		Chloro-2-methylaniline HCl, 4-	3165-93-3	1.2E+00	c	5.0E+00	c					1.7E-01	c		1.5E-04	c	
1.0E-01	P	7.7E-05	C	3.0E-03	X					1	0.1		Chloro-2-methylaniline, 4-	95-69-2	5.4E+00	c*	2.3E+01	c	3.6E-02	c	1.6E-01	c	7.0E-01	c*		4.0E-04	c*	
2.7E-01	X							V		1		1.2E+04	Chloroacetaldehyde, 2-	107-20-0	2.6E+00	c	1.2E+01	c					2.9E-01	c		5.8E-05	c	
										1	0.1		Chloroacetic Acid	79-11-8											6.0E+01			1.2E-02
						3.0E-05	I			1	0.1		Chloroacetophenone, 2-	532-27-4	4.3E+04	n	1.8E+05	nm	3.1E-02	n	1.3E-01	n						
2.0E-01	P			4.0E-03	I					1	0.1		Chloroaniline, p-	106-47-8	2.7E+00	c*	1.1E+01	c					3.7E-01	c		1.6E-04	c	
				2.0E-02	I	5.0E-02	P	V		1		7.6E+02	Chlorobenzene	108-90-7	2.8E+02	n	1.3E+03	ns	5.2E+01	n	2.2E+02	n	7.8E+01	n	1.0E+02	5.3E-02	n	6.8E-02
				1.0E-01	X					1	0.1		Chlorobenzene sulfonic acid, p-	98-66-8	6.3E+03	n	8.2E+04	n					2.0E+03	n		4.7E-01	n	
1.1E-01	C	3.1E-05	C	2.0E-02	I					1	0.1		Chlorobenzilate	510-15-6	4.9E+00	c	2.1E+01	c	9.1E-02	c	4.0E-01	c	3.1E-01	c		1.0E-03	c	
				3.0E-02	X					1	0.1		Chlorobenzoic Acid, p-	74-11-3	1.9E+03	n	2.5E+04	n					5.1E+02	n		1.3E-01	n	
				3.0E-03	P	3.0E-01	P	V		1		2.9E+02	Chlorobenzotrifluoride, 4-	98-56-6	2.1E+02	n	2.5E+03	ns	3.1E+02	n	1.3E+03	n	3.5E+01	n		1.2E-01	n	
				4.0E-02	P			V		1		7.3E+02	Chlorobutane, 1-	109-69-3	3.1E+03	ns	4.7E+04	ns					6.4E+02	n		2.6E-01	n	
						5.0E+01	I	V		1		1.7E+03	Chlorodifluoromethane	75-45-6	4.9E+04	ns	2.1E+05	nms	5.2E+04	n	2.2E+05	n	1.0E+05	n		4.3E+01	n	
				2.0E-02	P			V		1		1.1E+05	Chloroethanol, 2-	107-07-3	1.6E+03	n	2.3E+04	n					4.0E+02	n		8.1E-02	n	
3.1E-02	C	2.3E-05	I	1.0E-02	I	9.8E-02	A	V		1		2.5E+03	Chloroform	67-66-3	3.2E-01	c	1.4E+00	c	1.2E-01	c	5.3E-01	c	2.2E-01	c	8.0E+01(F)	6.1E-05	c	2.2E-02
						9.0E-02	I	V		1		1.3E+03	Chloromethane	74-87-3	1.1E+02	n	4.6E+02	n	9.4E+01	n	3.9E+02	n	1.9E+02	n		4.9E-02	n	
2.4E+00	C	6.9E-04	C					V		1		9.3E+03	Chloromethyl Methyl Ether	107-30-2	2.0E-02	c	8.9E-02	c	4.1E-03	c	1.8E-02	c	6.5E-03	c		1.4E-06	c	
3.0E-01	P			3.0E-03	P	1.0E-05	X			1	0.1		Chloronitrobenzene, o-	88-73-3	1.8E+00	c	7.7E+00	c	1.0E-02	n	4.4E-02	n	2.4E-01	c		2.2E-04	c	
6.0E-02	P			7.0E-04	P	2.0E-03	P			1	0.1		Chloronitrobenzene, p-	100-00-5	9.0E+00	c**	3.8E+01	c*	2.1E+00	n	8.8E+00	n	1.2E+00	c*		1.1E-03	c*	
				5.0E-03	I			V		1		2.7E+04	Chlorophenol, 2-	95-57-8	3.9E+02	n	5.8E+03	n					9.1E+01	n		8.9E-03	n	
						4.0E-04	C	V		1		6.2E+02	Chloropicrin	76-06-2	2.0E+00	n	8.2E+00	n	4.2E-01	n	1.8E+00	n	8.3E-01	n		2.5E-04	n	
3.1E-03	C	8.9E-07	C	1.5E-02	I					1	0.1		Chlorothalonil	1897-45-6	1.8E+02	c**	7.4E+02	c*	3.2E+00	c	1.4E+01	c	2.2E+01	c*		5.0E-02	c*	
				2.0E-02	I			V		1		9.1E+02	Chlorotoluene, o-	95-49-8	1.6E+03	ns	2.3E+04	ns					2.4E+02	n		2.3E-01	n	
				2.0E-02	X			V		1		2.5E+02	Chlorotoluene, p-	106-43-4	1.6E+03	ns	2.3E+04	ns					2.5E+02	n		2.4E-01	n	
2.4E+02	C	6.9E-02	C							1	0.1		Chlorozotocin	54749-90-5	2.3E-03	c	9.6E-03	c	4.1E-05	c	1.8E-04	c	3.2E-04	c		7.1E-08	c	
				5.0E-02	O					1	0.1		Chlorpropham	101-21-3	3.2E+03	n	4.1E+04	n					7.1E+02	n		6.4E-01	n	
				1.0E-03	A					1	0.1		Chlorpyrifos	2921-88-2	6.3E+01	n	8.2E+02	n					8.4E+00	n		1.2E-01	n	
				1.0E-02	H					1	0.1		Chlorpyrifos Methyl	5598-13-0	6.3E+02	n	8.2E+03	n					1.2E+02	n		5.4E-01	n	
				2.0E-02	O					1	0.1		Chlorsulfuron	64902-72-3	1.3E+03	n	1.6E+04	n					3.9E+02	n		3.3E-01	n	
				1.0E-02	I					1	0.1		Chlorthal-dimethyl	1861-32-1	6.3E+02	n	8.2E+03	n					1.2E+02	n		1.5E-01	n	
				8.0E-04	H					1	0.1		Chlorthiophos	60238-56-4	5.1E+01	n	6.6E+02	n					2.8E+00	n		7.3E-02	n	
				1.5E+00	I					0.013			Chromium(III), Insoluble Salts	16065-83-1	1.2E+05	nm	1.8E+06	nm					2.2E+04	n		4.0E+07	n	

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PRRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information													Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD$_o$ (mg/kg-day)	key	RfC$_i$ (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C$_{sat}$ (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
5.0E-01	C	8.4E-02	S	3.0E-03	I	1.0E-04	I		M	0.025			Chromium(VI)	18540-29-9	3.0E-01	c	6.3E+00	c	1.2E-05	c	1.5E-04	c	3.5E-02	c		6.7E-04	c	
										0.013			Chromium, Total	7440-47-3											1.0E+02			1.8E+05
				1.3E-02	I					1	0.1		Clofentezine	74115-24-5	8.2E+02	n	1.1E+04	n					2.3E+02	n		1.4E+01	n	
		9.0E-03	P	3.0E-04	P	6.0E-06	P			1			Cobalt	7440-48-4	2.3E+01	n	3.5E+02	n	3.1E-04	c*	1.4E-03	c*	6.0E+00	n		2.7E-01	n	
		6.2E-04	I					V	M	1			Coke Oven Emissions	8007-45-2					1.6E-03	c	2.0E-02	c						
				4.0E-02	H					1			Copper	7440-50-8	3.1E+03	n	4.7E+04	n					8.0E+02	n	1.3E+03	2.8E+01	n	4.6E+01
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, m-	108-39-4	3.2E+03	n	4.1E+04	n	6.3E+02	n	2.6E+03	n	9.3E+02	n		7.4E-01	n	
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, o-	95-48-7	3.2E+03	n	4.1E+04	n	6.3E+02	n	2.6E+03	n	9.3E+02	n		7.5E-01	n	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresol, p-	106-44-5	6.3E+03	n	8.2E+04	n	6.3E+02	n	2.6E+03	n	1.9E+03	n		1.5E+00	n	
				1.0E-01	A					1	0.1		Cresol, p-chloro-m-	59-50-7	6.3E+03	n	8.2E+04	n					1.4E+03	n		1.7E+00	n	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresols	1319-77-3	6.3E+03	n	8.2E+04	n	6.3E+02	n	2.6E+03	n	1.5E+03	n		1.3E+00	n	
1.9E+00	H			1.0E-03	P			V		1		1.7E+04	Crotonaldehyde, trans-	123-73-9	3.7E-01	c	1.7E+00	c					4.0E-02	c		8.2E-06	c	
				1.0E-01	I	4.0E-01	I	V		1		2.7E+02	Cumene	98-82-8	1.9E+03	ns	9.9E+03	ns	4.2E+02	n	1.8E+03	n	4.5E+02	n		7.4E-01	n	
2.2E-01	C	6.3E-05	C							1	0.1		Cupferron	135-20-6	2.5E+00	c	1.0E+01	c	4.5E-02	c	1.9E-01	c	3.5E-01	c		6.1E-04	c	
8.4E-01	H			2.0E-03	H					1	0.1		Cyanazine	21725-46-2	6.5E-01	c	2.7E+00	c					8.8E-02	c		4.1E-05	c	
													Cyanides																
				1.0E-03	I					1			~Calcium Cyanide	592-01-8	7.8E+01	n	1.2E+03	n					2.0E+01	n			n	
				5.0E-03	I					1			~Copper Cyanide	544-92-3	3.9E+02	n	5.8E+03	n					1.0E+02	n			n	
				6.0E-04	I	8.0E-04	S	V		1		9.5E+05	~Cyanide (CN-)	57-12-5	2.3E+01	n	1.5E+02	n	8.3E-01	n	3.5E+00	n	1.5E+00	n	2.0E+02	1.5E-02	n	2.0E+00
				1.0E-03	I			V		1			~Cyanogen	460-19-5	7.8E+01	n	1.2E+03	n					2.0E+01	n			n	
				9.0E-02	I			V		1			~Cyanogen Bromide	506-68-3	7.0E+03	n	1.1E+05	nm					1.8E+03	n			n	
				5.0E-02	I			V		1			~Cyanogen Chloride	506-77-4	3.9E+03	n	5.8E+04	n					1.0E+03	n			n	
				6.0E-04	I	8.0E-04	I	V		1		1.0E+07	~Hydrogen Cyanide	74-90-8	2.3E+01	n	1.5E+02	n	8.3E-01	n	3.5E+00	n	1.5E+00	n		1.5E-02	n	
				2.0E-03	I					1			~Potassium Cyanide	151-50-8	1.6E+02	n	2.3E+03	n					4.0E+01	n			n	
				5.0E-03	I					0.04			~Potassium Silver Cyanide	506-61-6	3.9E+02	n	5.8E+03	n					8.2E+01	n			n	
				1.0E-01	I					0.04			~Silver Cyanide	506-64-9	7.8E+03	n	1.2E+05	nm					1.8E+03	n			n	
				1.0E-03	I					1			~Sodium Cyanide	143-33-9	7.8E+01	n	1.2E+03	n					2.0E+01	n	2.0E+02		n	
				2.0E-04	P					1			~Thiocyanates	E1790664	1.6E+01	n	2.3E+02	n					4.0E+00	n			n	
				2.0E-04	X			V		1			~Thiocyanic Acid	463-56-9	1.6E+01	n	2.3E+02	n					4.0E+00	n			n	
				5.0E-02	I					1			~Zinc Cyanide	557-21-1	3.9E+03	n	5.8E+04	n					1.0E+03	n			n	
						6.0E+00	I	V		1		1.2E+02	Cyclohexane	110-82-7	6.5E+03	ns	2.7E+04	ns	6.3E+03	n	2.6E+04	n	1.3E+04	n		1.3E+01	n	
2.0E-02	X			2.0E-02	X					1	0.1		Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2α,3β,4α,5α,6β)-	87-84-3	2.7E+01	c*	1.1E+02	c					2.8E+00	c		1.6E-02	c	
				5.0E+00	I	7.0E-01	P	V		1		5.1E+03	Cyclohexanone	108-94-1	2.8E+04	ns	1.3E+05	nms	7.3E+02	n	3.1E+03	n	1.4E+03	n		3.4E-01	n	
				5.0E-03	P	1.0E+00	X	V		1		2.8E+02	Cyclohexene	110-83-8	3.1E+02	ns	3.1E+03	ns	1.0E+03	n	4.4E+03	n	7.0E+01	n		4.6E-02	n	
				2.0E-01	I			V		1		2.9E+05	Cyclohexylamine	108-91-8	1.6E+04	n	2.3E+05	nm					3.8E+03	n		1.0E+00	n	
				2.5E-02	I					1	0.1		Cyfluthrin	68359-37-5	1.6E+03	n	2.1E+04	n					1.2E+02	n		3.1E+01	n	
				1.0E-03	O					1	0.1		Cyhalothrin	68085-85-8	6.3E+01	n	8.2E+02	n					2.0E+01	n		1.4E+01	n	
				6.0E-02	O					1	0.1		Cypermethrin	52315-07-8	3.8E+03	n	4.9E+04	n					1.2E+03	n		1.9E+02	n	
				1.5E-02	O					1	0.1		Cyromazine	66215-27-8	9.5E+02	n	1.2E+04	n					3.0E+02	n		7.6E-02	n	
2.4E-01	I	6.9E-05	C							1	0.1		DDD	72-54-8	2.3E+00	c	9.6E+00	c	4.1E-02	c	1.8E-01	c	3.2E-02	c		7.5E-03	c	
3.4E-01	I	9.7E-05	C					V		1			DDE, p,p'	72-55-9	2.0E+00	c	9.3E+00	c	2.9E-02	c	1.3E-01	c	4.6E-02	c		1.1E-02	c	
3.4E-01	I	9.7E-05	I	5.0E-04	I					1	0.03		DDT	50-29-3	1.9E+00	c*	8.5E+00	c*	2.9E-02	c	1.3E-01	c	2.3E-01	c*		7.7E-02	c*	
				3.0E-02	I					1	0.1		Dalapon	75-99-0	1.9E+03	n	2.5E+04	n					6.0E+02	n	2.0E+02	1.2E-01	n	4.1E-02
1.8E-02	C	5.1E-06	C	1.5E-01	I					1	0.1		Daminozide	1596-84-5	3.0E+01	c	1.3E+02	c	5.5E-01	c	2.4E+00	c	4.3E+00	c		8.5E-04	c	
7.0E-04	I			7.0E-03	I					1	0.1		Decabromodiphenyl ether, 2,2',3,3',4,4',5,5',6,6'- (BDE-209)	1163-19-5	4.4E+02	n	3.3E+03	c**					1.1E+02	c**		8.2E+01	c**	
				4.0E-05	I					1	0.1		Demeton	8065-48-3	2.5E+00	n	3.3E+01	n					4.2E-01	n			n	
1.2E-03	I			6.0E-01	I					1	0.1		Di(2-ethylhexyl)adipate	103-23-1	4.5E+02	c*	1.9E+03	c					6.5E+01	c	4.0E+02	4.7E+00	c	2.9E+01
6.1E-02	H									1	0.1		Diallate	2303-16-4	8.9E+00	c	3.8E+01	c					5.4E-01	c		8.0E-04	c	
				7.0E-04	A					1	0.1		Diazinon	333-41-5	4.4E+01	n	5.7E+02	n					1.0E+01	n		6.5E-02	n	
				1.0E-02	X			V		1			Dibenzothiophene	132-65-0	7.8E+02	n	1.2E+04	n					6.5E+01	n		1.7E+00	n	
8.0E-01	P	6.0E-03	P	2.0E-04	P	2.0E-04	I	V	M	1		9.8E+02	Dibromo-3-chloropropane, 1,2-	96-12-8	5.3E-03	c	6.4E-02	c	1.7E-04	c	2.0E-03	c	3.3E-04	c	2.0E-01	1.4E-07	c	8.6E-05
				4.0E-04	X			V		1		1.6E+02	Dibromobenzene, 1,3-	108-36-1	3.1E+01	n	4.7E+02	ns					5.3E+00	n		5.1E-03	n	
				1.0E-02	I			V		1			Dibromobenzene, 1,4-	106-37-6	7.8E+02	n	1.2E+04	n					1.3E+02	n		1.2E-01	n	
8.4E-02	I			2.0E-02	I			V		1		8.0E+02	Dibromochloromethane	124-48-1	8.3E+00	c	3.9E+01	c					8.7E-01	c	8.0E+01(F)	2.3E-04	c	2.1E-02
2.0E+00	I	6.0E-04	I	9.0E-03	I	9.0E-03	I	V		1		1.3E+03	Dibromoethane, 1,2-	106-93-4	3.6E-02	c	1.6E-01	c	4.7E-03	c	2.0E-02	c	7.5E-03	c	5.0E-02	2.1E-06	c	1.4E-05
						4.0E-03	X	V		1		2.8E+03	Dibromomethane (Methylene Bromide)	74-95-3	2.4E+01	n	9.9E+01	n	4.2E+00	n	1.8E+01	n	8.3E+00	n		2.1E-03	n	
				3.0E-04	P					1	0.1		Dibutyltin Compounds	E1790660	1.9E+01	n	2.5E+02	n					6.0E+00	n			n	
				3.0E-02	I					1	0.1		Dicamba	1918-00-9	1.9E+03	n	2.5E+04	n					5.7E+02	n		1.5E-01	n	
		4.2E-03	P					V		1		5.5E+02	Dichloro-2-butene, 1,4-	764-41-0	2.1E-03	c	9.4E-03	c	6.7E-04	c	2.9E-03	c	1.3E-03	c		6.6E-07	c	
		4.2E-03	P					V		1		5.2E+02	Dichloro-2-butene, cis-1,4-	1476-11-5	7.4E-03	c	3.2E-02	c	6.7E-04	c	2.9E-03	c	1.3E-03	c		6.2E-07	c	
		4.2E-03	P					V		1		7.6E+02	Dichloro-2-butene, trans-1,4-	110-57-6	7.4E-03	c	3.2E-02	c	6.7E-04	c	2.9E-03	c	1.3E-03	c		6.2E-07	c	
5.0E-02	I			4.0E-03	I					1	0.1		Dichloroacetic Acid	79-43-6	1.1E+01	c*	4.6E+01	c*					1.5E+00	c*	6.0E+01	3.1E-04	c*	1.2E-02
				9.0E-02	I	2.0E-01	H	V		1		3.8E+02	Dichlorobenzene, 1,2-	95-50-1	1.8E+03	ns	9.3E+03	ns	2.1E+02	n	8.8E+02	n	3.0E+02	n	6.0E+02	3.0E-01	n	5.8E-01
5.4E-03	C	1.1E-05	C	7.0E-02	A	8.0E-01	I	V		1			Dichlorobenzene, 1,4-	106-46-7	2.6E+00	c	1.1E+01	c	2.6E-01	c	1.1E+00	c	4.8E-01	c	7.5E+01	4.6E-04	c	7.2E-02
4.5E-01	I	3.4E-04	C							1	0.1		Dichlorobenzidine, 3,3'-	91-94-1	1.2E+00	c	5.1E+00	c	8.3E-03	c	3.6E-02	c	1.3E-01	c		8.2E-04	c	
				9.0E-03	X					1	0.1		Dichlorobenzophenone, 4,4'-	90-98-2	5.7E+02	n	7.4E+03	n					7.8E+01	n		4.7E-01	n	
				2.0E-01	I	1.0E-01	X	V		1		8.5E+02	Dichlorodifluoromethane	75-71-8	8.7E+01	n	3.7E+02	n	1.0E+02	n	4.4E+02	n	2.0E+02	n		3.0E-01	n	
5.7E-03	C	1.6E-06	C	2.0E-01	P			V		1		1.7E+03	Dichloroethane, 1,1-	75-34-3	3.6E+00	c	1.6E+01	c	1.8E+00	c	7.7E+00	c	2.8E+00	c		7.8E-04	c	
9.1E-02	I	2.6E-05	I	6.0E-03	X	7.0E-03	P	V		1		3.0E+03	Dichloroethane, 1,2-	107-06-2	4.6E-01	c*	2.0E+00	c*	1.1E-01	c*	4.7E-01	c*	1.7E-01	c*	5.0E+00	4.8E-05	c*	1.4E-03
				5.0E-02	I	2.0E-01	I	V		1		1.2E+03	Dichloroethylene, 1,1-	75-35-4	2.3E+02	n	1.0E+03	n	2.1E+02	n	8.8E+02	n	2.8E+02	n	7.0E+00	1.0E-01	n	2.5E-03
				2.0E-03	I			V		1		2.4E+03	Dichloroethylene, 1,2-cis-	156-59-2	1.6E+02	n	2.3E+03	n					3.6E+01	n	7.0E+01	1.1E-02	n	2.1E-02
				2.0E-02	I			V		1		1.9E+03	Dichloroethylene, 1,2-trans-	156-60-5	1.6E+03	n	2.3E+04	ns					3.6E+02	n	1.0E+02	1.1E-01	n	3.1E-02
				3.0E-03	I					1	0.1		Dichlorophenol, 2,4-	120-83-2	1.9E+02	n	2.5E+03	n					4.6E+01	n		2.3E-02	n	
				1.0E-02	I					1	0.05		Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	7.0E+02	n	9.6E+03	n					1.7E+02	n	7.0E+01	4.5E-02	n	1.8E-02
3.7E-02	P	3.7E-05	P	4.0E-02	P	4.0E-03	I	V		1		1.4E+03	Dichloropropane, 1,2-	78-87-5	2.8E-01	c*	1.2E+00	c*	7.6E-02	c*	3.3E-01	c*	1.4E-01	c*	5.0E+00	4.7E-05	c*	1.7E-03
				2.0E-02	P			V		1		1.5E+03	Dichloropropane, 1,3-	142-28-9	1.6E+03	ns	2.3E+04	ns					3.7E+02	n		1.3E-01	n	

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				3.0E-03	I					1	0.1		Dichloropropanol, 2,3-	616-23-9	1.9E+02	n	2.5E+03	n					5.9E+01	n		1.3E-02	n	
1.0E-01	I	4.0E-06	I	3.0E-02	I	2.0E-02	I	V		1		1.6E+03	Dichloropropene, 1,3-	542-75-6	1.8E+00	c*	8.2E+00	c*	7.0E-01	c*	3.1E+00	c*	4.7E-01	c*		1.7E-04	c*	
2.9E-01	I	8.3E-05	C	5.0E-04	I	5.0E-04	I			1	0.1		Dichlorvos	62-73-7	1.9E+00	c*	7.9E+00	c*	3.4E-02	c*	1.5E-01	c*	2.6E-01	c*		8.1E-05	c*	
				7.0E-05	O					1	0.1		Dicrotophos	141-66-2	4.4E+00	n	5.7E+01	n					1.4E+00	n		3.3E-04	n	
				8.0E-02	P	3.0E-04	X	V		1		2.6E+02	Dicyclopentadiene	77-73-6	1.3E+00	n	5.4E+00	n	3.1E-01	n	1.3E+00	n	6.3E-01	n		2.2E-03	n	
1.6E+01	I	4.6E-03	I	5.0E-05	I					1	0.1		Dieldrin	60-57-1	3.4E-02	c*	1.4E-01	c	6.1E-04	c	2.7E-03	c	1.8E-03	c		7.1E-05	c	
		3.0E-04	C			5.0E-03	I			1	0.1		Diesel Engine Exhaust	E17136615					9.4E-03	c	4.1E-02	c						
				2.0E-03	P	2.0E-04	P			1	0.1		Diethanolamine	111-42-2	1.3E+02	n	1.6E+03	n	2.1E-01	n	8.8E-01	n	4.0E+01	n		8.1E-03	n	
				3.0E-02	P	1.0E-04	P			1	0.1		Diethylene Glycol Monobutyl Ether	112-34-5	1.9E+03	n	2.4E+04	n	1.0E-01	n	4.4E-01	n	6.0E+02	n		1.3E-01	n	
				6.0E-02	P	3.0E-04	P			1	0.1		Diethylene Glycol Monoethyl Ether	111-90-0	3.8E+03	n	4.8E+04	n	3.1E-01	n	1.3E+00	n	1.2E+03	n		2.4E-01	n	
				1.0E-03	P			V		1		1.1E+05	Diethylformamide	617-84-5	7.8E+01	n	1.2E+03	n					2.0E+01	n		4.1E-03	n	
3.5E+02	C	1.0E-01	C							1	0.1		Diethylstilbestrol	56-53-1	1.6E-03	c	6.6E-03	c	2.8E-05	c	1.2E-04	c	5.1E-05	c		2.9E-05	c	
				8.3E-02	O					1	0.1		Difenzoquat	43222-48-6	5.2E+03	n	6.8E+04	n					1.7E+03	n		2.6E+02	n	
				2.0E-02	I					1	0.1		Diflubenzuron	35367-38-5	1.3E+03	n	1.6E+04	n					2.9E+02	n		3.3E-01	n	
						4.0E+01	I	V		1		1.4E+03	Difluoroethane, 1,1-	75-37-6	4.8E+04	ns	2.0E+05	nms	4.2E+04	n	1.8E+05	n	8.3E+04	n		2.8E+01	n	
4.4E-02	C	1.3E-05	C					V		1			Dihydrosafrole	94-58-6	9.9E+00	c	4.5E+01	c	2.2E-01	c	9.4E-01	c	3.0E-01	c		1.9E-04	c	
						7.0E-01	P	V		1		2.3E+03	Diisopropyl Ether	108-20-3	2.2E+03	n	9.4E+03	ns	7.3E+02	n	3.1E+03	n	1.5E+03	n		3.7E-01	n	
				8.0E-02	I			V		1		5.3E+02	Diisopropyl Methylphosphonate	1445-75-6	6.3E+03	ns	9.3E+04	ns					1.6E+03	n		4.5E-01	n	
				2.2E-02	O					1	0.1		Dimethipin	55290-64-7	1.4E+03	n	1.8E+04	n					4.4E+02	n		9.6E-02	n	
				2.2E-03	O					1	0.1		Dimethoate	60-51-5	1.4E+02	n	1.8E+03	n					4.4E+01	n		9.9E-03	n	
1.6E+00	P									1	0.1		Dimethoxybenzidine, 3,3'-	119-90-4	3.4E-01	c	1.4E+00	c					4.7E-02	c		5.8E-05	c	
1.7E-03	P			6.0E-02	P					1	0.1		Dimethyl methylphosphonate	756-79-6	3.2E+02	c*	1.4E+03	c*					4.6E+01	c*		9.6E-03	c*	
4.6E+00	C	1.3E-03	C							1	0.1		Dimethylamino azobenzene [p-]	60-11-7	1.2E-01	c	5.0E-01	c	2.2E-03	c	9.4E-03	c	5.0E-03	c		2.1E-05	c	
5.8E-01	H									1	0.1		Dimethylaniline HCl, 2,4-	21436-96-4	9.4E-01	c	4.0E+00	c					1.3E-01	c		1.2E-04	c	
2.0E-01	P			2.0E-03	X					1	0.1		Dimethylaniline, 2,4-	95-68-1	2.7E+00	c*	1.1E+01	c					3.7E-01	c		2.1E-04	c	
2.7E-02	P			2.0E-03	I			V		1		8.3E+02	Dimethylaniline, N,N-	121-69-7	2.6E+01	c**	1.2E+02	c*					2.5E+00	c*		9.0E-04	c*	
1.1E+01	P									1	0.1		Dimethylbenzidine, 3,3'-	119-93-7	4.9E-02	c	2.1E-01	c					6.5E-03	c		4.3E-05	c	
				1.0E-01	P	3.0E-02	I	V		1		1.1E+05	Dimethylformamide	68-12-2	2.6E+03	n	1.5E+04	n	3.1E+01	n	1.3E+02	n	6.1E+01	n		1.2E-02	n	
				1.0E-04	X	2.0E-06	X	V		1		1.7E+05	Dimethylhydrazine, 1,1-	57-14-7	5.7E-02	n	2.4E-01	n	2.1E-03	n	8.8E-03	n	4.2E-03	n		9.3E-07	n	
5.5E+02	C	1.6E-01	C					V		1		1.9E+05	Dimethylhydrazine, 1,2-	540-73-8	8.8E-04	c	4.1E-03	c	1.8E-05	c	7.7E-05	c	2.8E-05	c		6.5E-09	c	
				2.0E-02	I					1	0.1		Dimethylphenol, 2,4-	105-67-9	1.3E+03	n	1.6E+04	n					3.6E+02	n		4.2E-01	n	
				6.0E-04	I					1	0.1		Dimethylphenol, 2,6-	576-26-1	3.8E+01	n	4.9E+02	n					1.1E+01	n		1.3E-02	n	
				1.0E-03	I					1	0.1		Dimethylphenol, 3,4-	95-65-8	6.3E+01	n	8.2E+02	n					1.8E+01	n		2.1E-02	n	
4.5E-02	C	1.3E-05	C					V		1		4.7E+02	Dimethylvinylchloride	513-37-1	1.1E+00	c	4.8E+00	c	2.2E-01	c	9.4E-01	c	3.3E-01	c		1.1E-04	c	
				8.0E-05	X					1	0.1		Dinitro-o-cresol [4,6-	534-52-1	5.1E+00	n	6.6E+01	n					1.5E+00	n		2.6E-03	n	
				2.0E-03	I					1	0.1		Dinitro-o-cyclohexyl Phenol [4,6-	131-89-5	1.3E+02	n	1.6E+03	n					2.3E+01	n		7.7E-01	n	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,2-	528-29-0	6.3E+00	n	8.2E+01	n					1.9E+00	n		1.8E-03	n	
				1.0E-04	I					1	0.1		Dinitrobenzene, 1,3-	99-65-0	6.3E+00	n	8.2E+01	n					2.0E+00	n		1.8E-03	n	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,4-	100-25-4	6.3E+00	n	8.2E+01	n					2.0E+00	n		1.8E-03	n	
				2.0E-03	I					1	0.1		Dinitrophenol, 2,4-	51-28-5	1.3E+02	n	1.6E+03	n					3.9E+01	n		4.4E-02	n	
6.8E-01	I									1	0.1		Dinitrotoluene Mixture, 2,4/2,6-	E1615210	8.0E-01	c	3.4E+00	c					1.1E-01	c		1.6E-04	c	
3.1E-01	C	8.9E-05	C	2.0E-03	I					1	0.102		Dinitrotoluene, 2,4-	121-14-2	1.7E+00	c*	7.4E+00	c	3.2E-02	c	1.4E-01	c	2.4E-01	c		3.2E-04	c	
1.5E+00	P			3.0E-04	X					1	0.099		Dinitrotoluene, 2,6-	606-20-2	3.6E-01	c*	1.5E+00	c					4.9E-02	c		6.7E-05	c	
				2.0E-03	S					1	0.006		Dinitrotoluene, 2,6-amino-4,8-	35572-78-2	1.5E+02	n	2.3E+03	n					3.9E+01	n		3.0E-02	n	
				2.0E-03	S					1	0.009		Dinitrotoluene, 4,6-amino-2,8-	19406-51-0	1.5E+02	n	2.3E+03	n					3.9E+01	n		3.0E-02	n	
4.5E-01	X			9.0E-04	X					1	0.1		Dinitrotoluene, Technical grade	25321-14-6	1.2E+00	c*	5.1E+00	c					1.0E-01	c		1.4E-04	c	
				1.0E-03	I					1	0.1		Dinoseb	88-85-7	6.3E+01	n	8.2E+02	n					1.5E+01	n	7.0E+00	1.3E-01	n	6.2E-02
1.0E-01	I	5.0E-06	I	3.0E-02	I	3.0E-02	I	V		1		1.2E+05	Dioxane, 1,4-	123-91-1	5.3E+00	c	2.4E+01	c	5.6E-01	c*	2.5E+00	c*	4.6E-01	c		9.4E-05	c	
													Dioxins															
6.2E+03	I	1.3E+00	I							1	0.03		~Hexachlorodibenzo-p-dioxin, Mixture		1.0E-04	c	4.7E-04	c	2.2E-06	c	9.4E-06	c	1.3E-05	c		1.7E-05	c	
1.3E+05	C	3.8E+01	C	7.0E-10	I	4.0E-08	C	V		1	0.03		~TCDD, 2,3,7,8-	1746-01-6	4.8E-06	c*	2.2E-05	c*	7.4E-08	c	3.2E-07	c	1.2E-07	c	3.0E-05	5.9E-06	c	1.5E-05
				3.0E-02	I					1	0.1		Diphenamid	957-51-7	1.9E+03	n	2.5E+04	n					5.3E+02	n		5.2E+00	n	
				8.0E-04	X					1	0.1		Diphenyl Sulfone	127-63-9	5.1E+01	n	6.6E+02	n					1.5E+01	n		3.6E-02	n	
				1.0E-01	O					1	0.1		Diphenylamine	122-39-4	6.3E+03	n	8.2E+04	n					1.3E+03	n		2.3E+00	n	
8.0E-01	I	2.2E-04	I							1	0.1		Diphenylhydrazine, 1,2-	122-66-7	6.8E-01	c	2.9E+00	c	1.3E-02	c	5.6E-02	c	7.8E-02	c		2.5E-04	c	
				2.2E-03	I					1	0.1		Diquat	85-00-7	1.4E+02	n	1.8E+03	n					4.4E+01	n	2.0E+01	8.3E-01	n	3.7E-01
7.1E+00	C	1.4E-01	C							1	0.1		Direct Black 38	1937-37-7	7.6E-02	c	3.2E-01	c	2.0E-05	c	8.8E-05	c	1.1E-02	c		5.3E+00	c	
7.4E+00	C	1.4E-01	C							1	0.1		Direct Blue 6	2602-46-2	7.3E-02	c	3.1E-01	c	2.0E-05	c	8.8E-05	c	1.1E-02	c		1.7E-01	c	
6.7E+00	C	1.4E-01	C							1	0.1		Direct Brown 95	16071-86-6	8.1E-02	c	3.4E-01	c	2.0E-05	c	8.8E-05	c	1.2E-02	c		1.6E-01	c	
				4.0E-05	I					1	0.1		Disulfoton	298-04-4	2.5E+00	n	3.3E+01	n					5.0E-01	n		9.4E-04	n	
				1.0E-02	I			V		1			Dithiane, 1,4-	505-29-3	7.8E+02	n	1.2E+04	n					2.0E+02	n		5.7E-02	n	
				2.0E-03	I					1	0.1		Diuron	330-54-1	1.3E+02	n	1.6E+03	n					3.6E+01	n		1.5E-02	n	
				2.0E-02	O					1	0.1		Dodine	2439-10-3	1.3E+03	n	1.6E+04	n					4.0E+02	n		2.1E+00	n	
				5.0E-02	O			V		1			EPTC	759-94-4	3.9E+03	n	5.8E+04	n					7.5E+02	n		4.0E-01	n	
				6.0E-03	I			V		1			Endosulfan	115-29-7	4.7E+02	n	7.0E+03	n					1.0E+02	n		1.4E+00	n	
				2.0E-02	I					1	0.1		Endothall	145-73-3	1.3E+03	n	1.6E+04	n					3.8E+02	n	1.0E+02	9.1E-02	n	2.4E-02
				3.0E-04	I					1	0.1		Endrin	72-20-8	1.9E+01	n	2.5E+02	n					2.3E+00	n	2.0E+00	9.2E-02	n	8.1E-02
9.9E-03	I	1.2E-06	I	6.0E-03	P	1.0E-03	I	V		1		1.1E+04	Epichlorohydrin	106-89-8	1.9E+01	n	8.2E+01	n	1.0E+00	n	4.4E+00	n	2.0E+00	n		4.5E-04	n	
						2.0E-02	I	V		1		1.5E+04	Epoxybutane, 1,2-	106-88-7	1.6E+02	n	6.7E+02	n	2.1E+01	n	8.8E+01	n	4.2E+01	n		9.2E-03	n	
				4.0E-02	P					1	0.1		Ethanol, 2-(2-methoxyethoxy)-	111-77-3	2.5E+03	n	3.3E+04	n					8.0E+02	n		1.9E-01	n	
				5.0E-03	I					1	0.1		Ethephon	16672-87-0	3.2E+02	n	4.1E+03	n					1.0E+02	n		2.1E-02	n	
				5.0E-04	I					1	0.1		Ethion	563-12-2	3.2E+01	n	4.1E+02	n					4.3E+00	n		8.5E-03	n	
				1.0E-01	P	6.0E-02	P	V		1		2.4E+04	Ethoxyethanol Acetate, 2-	111-15-9	2.6E+03	n	1.4E+04	n	6.3E+01	n	2.6E+02	n	1.2E+02	n		2.5E-02	n	
				9.0E-02	P	2.0E-01	I	V		1		1.1E+05	Ethoxyethanol, 2-	110-80-5	5.2E+03	n	4.7E+04	n	2.1E+02	n	8.8E+02	n	3.4E+02	n		6.8E-02	n	
				9.0E-01	I	7.0E-02	P	V		1		1.1E+04	Ethyl Acetate	141-78-6	6.2E+02	n	2.6E+03	n	7.3E+01	n	3.1E+02	n	1.4E+02	n		3.1E-02	n	
				5.0E-03	P	8.0E-03	P	V		1		2.5E+03	Ethyl Acrylate	140-88-5	4.7E+01	n	2.1E+02	n	8.3E+00	n	3.5E+01	n	1.4E+01	n		3.2E-03	n	

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information														Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
						1.0E+01	I	V		1		2.1E+03	Ethyl Chloride (Chloroethane)	75-00-3	1.4E+04	ns	5.7E+04	ns	1.0E+04	n	4.4E+04	n	2.1E+04	n		5.9E+00	n		
				2.0E-01	I			V		1		1.0E+04	Ethyl Ether	60-29-7	1.6E+04	ns	2.3E+05	nms					3.9E+03	n		8.8E-01	n		
						3.0E-01	P	V		1		1.1E+03	Ethyl Methacrylate	97-63-2	1.8E+03	ns	7.6E+03	ns	3.1E+02	n	1.3E+03	n	6.3E+02	n		1.5E-01	n		
				1.0E-05	I					1	0.1		Ethyl-p-nitrophenyl Phosphonate	2104-64-5	6.3E-01	n	8.2E+00	n					8.9E-02	n		2.6E-03	n		
1.1E-02	C	2.5E-06	C	1.0E-01	I	1.0E+00	I	V		1		4.8E+02	Ethylbenzene	100-41-4	5.8E+00	c	2.5E+01	c	1.1E+00	c	4.9E+00	c	1.5E+00	c	7.0E+02	1.7E-03	c	7.8E-01	
				7.0E-02	P					1	0.1		Ethylene Cyanohydrin	109-78-4	4.4E+03	n	5.7E+04	n					1.4E+03	n		2.0E-01	n		
				9.0E-02	P			V		1		1.9E+05	Ethylene Diamine	107-15-3	7.0E+03	n	1.1E+05	nm					1.8E+03	n		4.1E-01	n		
				2.0E+00	I	4.0E-01	C			1	0.1		Ethylene Glycol	107-21-1	1.3E+05	nm	1.6E+06	nm	4.2E+02	n	1.8E+03	n	4.0E+04	n		8.1E+00	n		
				1.0E-01	I	1.6E+00	I			1	0.1		Ethylene Glycol Monobutyl Ether	111-76-2	6.3E+03	n	8.2E+04	n	1.7E+03	n	7.0E+03	n	2.0E+03	n		4.1E-01	n		
3.1E-01	C	3.0E-03	I			3.0E-02	C	V	M	1		1.2E+05	Ethylene Oxide	75-21-8	2.0E-03	c	2.5E-02	c	3.4E-04	c	4.1E-03	c	6.7E-04	c		1.4E-07	c		
4.5E-02	C	1.3E-05	C	8.0E-05	I					1	0.1		Ethylene Thiourea	96-45-7	5.1E+00	n	5.1E+01	c**	2.2E-01	c	9.4E-01	c	1.6E+00	n		3.6E-04	n		
6.5E+01	C	1.9E-02	C					V		1		1.5E+05	Ethyleneimine	151-56-4	2.7E-03	c	1.2E-02	c	1.5E-04	c	6.5E-04	c	2.4E-04	c		5.2E-06	c		
				3.0E+00	I					1	0.1		Ethylphthalyl Ethyl Glycolate	84-72-0	1.9E+05	nm	2.5E+06	nm					5.8E+04	n		1.3E+02	n		
				2.5E-04	I					1	0.1		Fenamiphos	22224-92-6	1.6E+01	n	2.1E+02	n					4.4E+00	n		4.3E-03	n		
				2.5E-02	I					1	0.1		Fenpropathrin	39515-41-8	1.6E+03	n	2.1E+04	n					6.4E+01	n		2.8E+00	n		
				2.5E-02	I					1	0.1		Fenvalerate	51630-58-1	1.6E+03	n	2.1E+04	n					5.0E+02	n		3.2E+02	n		
				1.3E-02	I					1	0.1		Fluometuron	2164-17-2	8.2E+02	n	1.1E+04	n					2.4E+02	n		1.0E-01	n		
				4.0E-02	C	1.3E-02	C			1			Fluoride	16984-48-8	3.1E+03	n	4.7E+04	n	1.4E+01	n	5.7E+01	n	8.0E+02	n		1.2E+02	n		
				6.0E-02	I	1.3E-02	C			1			Fluorine (Soluble Fluoride)	7782-41-4	4.7E+03	n	7.0E+04	n	1.4E+01	n	5.7E+01	n	1.2E+03	n	4.0E+03	1.8E+02	n	8.0E+02	
				8.0E-02	I					1	0.1		Fluridone	59756-60-4	5.1E+03	n	6.6E+04	n					1.4E+03	n		1.8E+02	n		
				1.5E-02	O					1	0.1		Flurprimidol	56425-91-3	9.5E+02	n	1.2E+04	n					2.6E+02	n		1.3E+00	n		
				2.0E-03	O					1	0.1		Flusilazole	85509-19-9	1.3E+02	n	1.6E+03	n					3.1E+01	n		5.1E+00	n		
				5.0E-01	O					1	0.1		Flutolanil	66332-96-5	3.2E+04	n	4.1E+05	nm					7.9E+03	n		4.2E+01	n		
				1.0E-02	I					1	0.1		Fluvalinate	69409-94-5	6.3E+02	n	8.2E+03	n					2.0E+02	n		2.9E+02	n		
				9.0E-02	O					1	0.1		Folpet	133-07-3	5.7E+03	n	7.4E+04	n					1.6E+03	n		3.9E-01	n		
				2.5E-03	O					1	0.1		Fomesafen	72178-02-0	1.6E+02	n	2.1E+03	n					4.8E+01	n		1.0E-01	n		
				2.0E-03	I					1	0.1		Fonofos	944-22-9	1.3E+02	n	1.6E+03	n					2.4E+01	n		4.7E-02	n		
		1.3E-05	I	2.0E-01	I	9.8E-03	A	V		1		4.2E+04	Formaldehyde	50-00-0	1.7E+01	c*	7.3E+01	c*	2.2E-01	c*	9.4E-01	c*	4.3E-01	c*		8.7E-05	c*		
				9.0E-01	P	3.0E-04	X	V		1		1.1E+05	Formic Acid	64-18-6	2.9E+01	n	1.2E+02	n	3.1E-01	n	1.3E+00	n	6.3E-01	n		1.3E-04	n		
				2.5E+00	O					1	0.1		Fosetyl-AL	39148-24-8	1.6E+05	nm	2.1E+06	nm					5.0E+04	n		6.6E+02	n		
													Furans																	
				1.0E-03	X			V		1	0.03		~Dibenzofuran	132-64-9	7.3E+01	n	1.0E+03	n					7.9E+00	n		1.5E-01	n		
				1.0E-03	I			V		1	0.03	6.2E+03	~Furan	110-00-9	7.3E+01	n	1.0E+03	n					1.9E+01	n		7.3E-03	n		
				9.0E-01	I	2.0E+00	I	V		1	0.03	1.7E+05	~Tetrahydrofuran	109-99-9	1.8E+04	n	9.4E+04	n	2.1E+03	n	8.8E+03	n	3.4E+03	n		7.5E-01	n		
3.8E+00	H									1	0.1		Furazolidone	67-45-8	1.4E-01	c	6.0E-01	c					2.0E-02	c		3.9E-05	c		
				3.0E-03	I	5.0E-02	H	V		1		1.0E+04	Furfural	98-01-1	2.1E+02	n	2.6E+03	n	5.2E+01	n	2.2E+02	n	3.8E+01	n		8.1E-03	n		
1.5E+00	C	4.3E-04	C							1	0.1		Furium	531-82-8	3.6E-01	c	1.5E+00	c	6.5E-03	c	2.9E-02	c	5.1E-02	c		6.8E-05	c		
3.0E-02	I	8.6E-06	C							1	0.1		Furmecyclox	60568-05-0	1.8E+01	c	7.7E+01	c	3.3E-01	c	1.4E+00	c	1.1E+00	c		1.2E-03	c		
				6.0E-03	O					1	0.1		Glufosinate, Ammonium	77182-82-2	3.8E+02	n	4.9E+03	n					1.2E+02	n		2.8E-02	n		
						8.0E-05	C			1	0.1		Glutaraldehyde	111-30-8	1.1E+05	nm	4.8E+05	nm	8.3E-02	n	3.5E-01	n							
				4.0E-04	I	1.0E-03	H	V		1		1.1E+05	Glycidyl	765-34-4	2.3E+01	n	2.1E+02	n	1.0E+00	n	4.4E+00	n	1.7E+00	n		3.3E-04	n		
				1.0E-01	I					1	0.1		Glyphosate	1071-83-6	6.3E+03	n	8.2E+04	n					2.0E+03	n	7.0E+02	6.8E+00	n	3.1E+00	
				1.0E-02	X			V		1			Guanidine	113-00-8	7.8E+02	n	1.2E+04	n					2.0E+02	n		4.5E-02	n		
				2.0E-02	P					1	0.1		Guanidine Chloride	50-01-1	1.3E+03	n	1.6E+04	n					4.0E+02	n			n		
				3.0E-02	X					1	0.1		Guanidine Nitrate	506-93-4	1.9E+03	n	2.5E+04	n					6.0E+02	n		1.5E-01	n		
				5.0E-05	I					1	0.1		Haloxyfop, Methyl	69806-40-2	3.2E+00	n	4.1E+01	n					7.6E-01	n		8.4E-03	n		
4.5E+00	I	1.3E-03	I	5.0E-04	I			V		1			Heptachlor	76-44-8	1.3E-01	c	6.3E-01	c	2.2E-03	c	9.4E-03	c	1.4E-03	c	4.0E-01	1.2E-04	c	3.3E-02	
9.1E+00	I	2.6E-03	I	1.3E-05	I			V		1			Heptachlor Epoxide	1024-57-3	7.0E-02	c*	3.3E-01	c*	1.1E-03	c	4.7E-03	c	1.4E-03	c*	2.0E-01	2.8E-05	c*	4.1E-03	
				3.0E-04	X	4.0E-01	P	V		1		5.8E+01	Heptane, N-	142-82-5	2.2E+01	n	2.9E+02	ns	4.2E+02	n	1.8E+03	n	6.0E+00	n		4.6E-02	n		
				2.0E-03	I			V		1			Hexabromobenzene	87-82-1	1.6E+02	n	2.3E+03	n					4.0E+01	n		2.3E-01	n		
				2.0E-04	I					1	0.1		Hexabromodiphenyl ether, 2,2',4,4',5,5'- (BDE-153)	68631-49-2	1.3E+01	n	1.6E+02	n					4.0E+00	n			n		
1.6E+00	I	4.6E-04	I	8.0E-04	I			V		1			Hexachlorobenzene	118-74-1	2.1E-01	c	9.6E-01	c	6.1E-03	c	2.7E-02	c	9.8E-03	c	1.0E+00	1.2E-04	c	1.3E-02	
7.8E-02	I	2.2E-05	I	1.0E-03	P			V		1		1.7E+01	Hexachlorobutadiene	87-68-3	1.2E+00	c*	5.3E+00	c	1.3E-01	c	5.6E-01	c	1.4E-01	c*		2.7E-04	c*		
6.3E+00	I	1.8E-03	I	8.0E-03	A					1	0.1		Hexachlorocyclohexane, Alpha-	319-84-6	8.6E-02	c	3.6E-01	c	1.6E-03	c	6.8E-03	c	7.2E-03	c		4.2E-05	c		
1.8E+00	I	5.3E-04	I							1	0.1		Hexachlorocyclohexane, Beta-	319-85-7	3.0E-01	c	1.3E+00	c	5.3E-03	c	2.3E-02	c	2.5E-02	c		1.5E-04	c		
1.1E+00	C	3.1E-04	C	3.0E-04	I					1	0.04		Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	5.7E-01	c*	2.5E+00	c	9.1E-03	c	4.0E-02	c	4.2E-02	c*	2.0E-01	2.4E-04	c*	1.2E-03	
1.8E+00	I	5.1E-04	I							1	0.1		Hexachlorocyclohexane, Technical	608-73-1	3.0E-01	c	1.3E+00	c	5.5E-03	c	2.4E-02	c	2.5E-02	c		1.5E-04	c		
				6.0E-03	I	2.0E-04	I	V		1		1.6E+01	Hexachlorocyclopentadiene	77-47-4	1.8E+00	n	7.5E+00	n	2.1E-01	n	8.8E-01	n	4.1E-01	n	5.0E+01	1.3E-03	n	1.6E-01	
4.0E-02	I	1.1E-05	C	7.0E-04	I	3.0E-02	I	V		1			Hexachloroethane	67-72-1	1.8E+00	c*	8.0E+00	c*	2.6E-01	c	1.1E+00	c	3.3E-01	c*		2.0E-04	c*		
				3.0E-04	I					1	0.1		Hexachlorophene	70-30-4	1.9E+01	n	2.5E+02	n					6.0E+00	n		8.0E+00	n		
1.1E-01	I			3.0E-03	I					1	0.015		Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	6.1E+00	c*	2.8E+01	c					7.0E-01	c*		2.7E-04	c*		
						1.0E-05	I	V		1		3.4E+03	Hexamethylene Diisocyanate, 1,6-	822-06-0	3.1E+00	n	1.3E+01	n	1.0E-02	n	4.4E-02	n	2.1E-02	n		2.1E-04	n		
				4.0E-04	P					1	0.1		Hexamethylphosphoramide	680-31-9	2.5E+01	n	3.3E+02	n					8.0E+00	n		1.8E-03	n		
						7.0E-01	I	V		1		1.4E+02	Hexane, N-	110-54-3	6.1E+02	ns	2.5E+03	ns	7.3E+02	n	3.1E+03	n	1.5E+03	n		1.0E+01	n		
				2.0E+00	P					1	0.1		Hexanedioic Acid	124-04-9	1.3E+05	nm	1.6E+06	nm					4.0E+04	n		9.9E+00	n		
				5.0E-03	I	3.0E-02	I	V		1		3.3E+03	Hexanone, 2-	591-78-6	2.0E+02	n	1.3E+03	n	3.1E+01	n	1.3E+02	n	3.8E+01	n		8.8E-03	n		
				3.3E-02	I					1	0.1		Hexazinone	51235-04-2	2.1E+03	n	2.7E+04	n					6.4E+02	n		3.0E-01	n		
				2.5E-02	I					1	0.1		Hexythiazox	78587-05-0	1.6E+03	n	2.1E+04	n					1.1E+02	n		5.0E-01	n		
				1.7E-02	O					1	0.1		Hydramethylnon	67485-29-4	1.1E+03	n	1.4E+04	n					3.4E+02	n		1.2E+05	n		
3.0E+00	I	4.9E-03	I			3.0E-05	P	V		1			Hydrazine	302-01-2	2.3E-01	c	1.1E+00	c	5.7E-04	c*	2.5E-03	c*	1.1E-03	c*			c*		
3.0E+00	I	4.9E-03	I							1			Hydrazine Sulfate	10034-93-2	2.3E-01	c	1.1E+00	c	5.7E-04	c	2.5E-03	c	2.6E-02	c			c		
						2.0E-02	I	V		1			Hydrogen Chloride	7647-01-0	2.8E+07	nm	1.2E+08	nm	2.1E+01	n	8.8E+01	n	4.2E+01	n			n		
				4.0E-02	C	1.4E-02	C	V		1			Hydrogen Fluoride	7664-39-3	3.1E+03	n	4.7E+04	n	1.5E+01	n	6.1E+01	n	2.8E+01	n			n		
						2.0E-03	I	V		1			Hydrogen Sulfide	7783-06-4	2.8E+06	nm	1.2E+07	nm	2.1E+00	n	8.8E+00	n	4.2E+00	n			n		
6.0E-02	P			4.0E-02	P					1	0.1		Hydroquinone	123-31-9	9.0E+00	c	3.8E+01	c					1.3E+00	c		8.7E-04	c		
6.1E-02	O			2.5E-03	O					1	0.1		Imazalil	35554-44-0	8.9E+00	c*	3.8E+01	c*					9.0E-01	c*		1.5E-02	c*		

TR=1E-06

THQ=1.0

ED_002842A_00000589-00165

Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PRRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD$_o$ (mg/kg-day)	key	RfC$_i$ (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C$_{sat}$ (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				2.5E-01	I					1	0.1		Imazaquin	81335-37-7	1.6E+04	n	2.1E+05	nm					4.9E+03	n		2.4E+01	n	
				2.5E+00	O					1	0.1		Imazethapyr	81335-77-5	1.6E+05	nm	2.1E+06	nm					4.7E+04	n		4.1E+01	n	
				1.0E-02	A					1			Iodine	7553-56-2	7.8E+02	n	1.2E+04	n					2.0E+02	n		1.2E+01	n	
				4.0E-02	I					1	0.1		Iprodione	36734-19-7	2.5E+03	n	3.3E+04	n					7.4E+02	n		2.2E-01	n	
				7.0E-01	P					1			Iron	7439-89-6	5.5E+04	n	8.2E+05	nm					1.4E+04	n		3.5E+02	n	
				3.0E-01	I			V		1		1.0E+04	Isobutyl Alcohol	78-83-1	2.3E+04	ns	3.5E+05	nms					5.9E+03	n		1.2E+00	n	
9.5E-04	I			2.0E-01	I	2.0E+00	C			1	0.1		Isophorone	78-59-1	5.7E+02	c*	2.4E+03	c*	2.1E+03	n	8.8E+03	n	7.8E+01	c*		2.0E-02	c*	
				1.5E-02	I			V		1			Isopropalin	33820-53-0	1.2E+03	n	1.8E+04	n					4.0E+01	n		9.2E-01	n	
				2.0E+00	P	2.0E-01	P	V		1		1.1E+05	Isopropanol	67-63-0	5.6E+03	n	2.4E+04	n	2.1E+02	n	8.8E+02	n	4.1E+02	n		8.4E-02	n	
				1.0E-01	I					1	0.1		Isopropyl Methyl Phosphonic Acid	1832-54-8	6.3E+03	n	8.2E+04	n					2.0E+03	n		4.3E-01	n	
				5.0E-02	I					1	0.1		Isoxaben	82558-50-7	3.2E+03	n	4.1E+04	n					7.3E+02	n		2.0E+00	n	
						3.0E-01	A	V		1			JP-7	E1737665	4.3E+08	nm	1.8E+09	nm	3.1E+02	n	1.3E+03	n	6.3E+02	n			n	
				8.0E-03	O					1	0.1		Lactofen	77501-63-4	5.1E+02	n	6.6E+03	n					1.0E+02	n		4.6E+00	n	
													Lead Compounds															
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			~Lead Chromate	7758-97-6	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
8.5E-03	C	1.2E-05	C							1			~Lead Phosphate	7446-27-7	8.2E+01	c	3.8E+02	c	2.3E-01	c	1.0E+00	c	9.1E+00	c			c	
8.5E-03	C	1.2E-05	C							1	0.1		~Lead acetate	301-04-2	6.4E+01	c	2.7E+02	c	2.3E-01	c	1.0E+00	c	9.2E+00	c		1.8E-03	c	
										1			~Lead and Compounds	7439-92-1	4.0E+02		8.0E+02	L	1.5E-01	L			1.5E+01	L	1.5E+01		L	1.4E+01
8.5E-03	C	1.2E-05	C							1	0.1		~Lead subacetate	1335-32-6	6.4E+01	c	2.7E+02	c	2.3E-01	c	1.0E+00	c	9.2E+00	c		2.0E-03	c	
				1.0E-07	I			V		1		2.4E+00	~Tetraethyl Lead	78-00-2	7.8E-03	n	1.2E-01	n					1.3E-03	n		4.7E-06	n	
				5.0E-06	P			V		1		3.8E+02	Lewisite	541-25-3	3.9E-01	n	5.8E+00	n					9.0E-02	n		3.8E-05	n	
				7.7E-03	O					1	0.1		Linuron	330-55-2	4.9E+02	n	6.3E+03	n					1.3E+02	n		1.1E-01	n	
				2.0E-03	P					1			Lithium	7439-93-2	1.6E+02	n	2.3E+03	n					4.0E+01	n		1.2E+01	n	
				5.0E-04	I					1	0.1		MCPA	94-74-6	3.2E+01	n	4.1E+02	n					7.5E+00	n		2.0E-03	n	
				4.4E-03	O					1	0.1		MCPB	94-81-5	2.8E+02	n	3.6E+03	n					6.5E+01	n		2.6E-02	n	
				1.0E-03	I					1	0.1		MCPP	93-65-2	6.3E+01	n	8.2E+02	n					1.6E+01	n		4.7E-03	n	
				2.0E-02	I					1	0.1		Malathion	121-75-5	1.3E+03	n	1.6E+04	n					3.9E+02	n		1.0E-01	n	
				1.0E-01	I	7.0E-04	C			1	0.1		Maleic Anhydride	108-31-6	6.3E+03	n	8.0E+04	n	7.3E-01	n	3.1E+00	n	1.9E+03	n		3.8E-01	n	
				5.0E-01	I					1	0.1		Maleic Hydrazide	123-33-1	3.2E+04	n	4.1E+05	nm					1.0E+04	n		2.1E+00	n	
				1.0E-04	P					1	0.1		Malononitrile	109-77-3	6.3E+00	n	8.2E+01	n					2.0E+00	n		4.1E-04	n	
				3.0E-02	H					1	0.1		Mancozeb	8018-01-7	1.9E+03	n	2.5E+04	n					5.4E+02	n		7.6E-01	n	
				5.0E-03	I					1	0.1		Maneb	12427-38-2	3.2E+02	n	4.1E+03	n					9.8E+01	n		1.4E-01	n	
				1.4E-01	I	5.0E-05	I			1			Manganese (Diet)	7439-96-5														
				2.4E-02	S	5.0E-05	I			0.04			Manganese (Non-Diet)	7439-96-5	1.8E+03	n	2.6E+04	n	5.2E-02	n	2.2E-01	n	4.3E+02	n		2.8E+01	n	
				9.0E-05	H					1	0.1		Mephosfolan	950-10-7	5.7E+00	n	7.4E+01	n					1.8E+00	n		2.6E-03	n	
				3.0E-02	I					1	0.1		Mepiquat Chloride	24307-26-4	1.9E+03	n	2.5E+04	n					6.0E+02	n		2.0E-01	n	
1.1E-02	P			4.0E-03	P					1	0.1		Mercaptobenzothiazole, 2-	149-30-4	4.9E+01	c**	2.1E+02	c*					6.3E+00	c*		1.8E-02	c*	
													Mercury Compounds															
				3.0E-04	I	3.0E-04	S			0.07			~Mercuric Chloride (and other Mercury salts)	7487-94-7	2.3E+01	n	3.5E+02	n	3.1E-01	n	1.3E+00	n	5.7E+00	n	2.0E+00		n	
						3.0E-04	I	V		1		3.1E+00	~Mercury (elemental)	7439-97-6	1.1E+01	ns	4.6E+01	ns	3.1E-01	n	1.3E+00	n	6.3E-01	n	2.0E+00	3.3E-02	n	1.0E-01
				1.0E-04	I					1			~Methyl Mercury	22967-92-6	7.8E+00	n	1.2E+02	n					2.0E+00	n			n	
				8.0E-05	I					1	0.1		~Phenylmercuric Acetate	62-38-4	5.1E+00	n	6.6E+01	n					1.6E+00	n		5.0E-04	n	
				3.0E-05	I			V		1			Merphos	150-50-5	2.3E+00	n	3.5E+01	n					6.0E-01	n		5.9E-02	n	
				1.0E-04	O					1	0.1		Merphos Oxide	78-48-8	6.3E+00	n	8.2E+01	n					2.8E-01	n		1.4E-03	n	
				6.0E-02	I					1	0.1		Metalaxyl	57837-19-1	3.8E+03	n	4.9E+04	n					1.2E+03	n		3.3E-01	n	
				1.0E-04	I	3.0E-02	P	V		1		4.6E+03	Methacrylonitrile	126-98-7	7.5E+00	n	1.0E+02	n	3.1E+01	n	1.3E+02	n	1.9E+00	n		4.3E-04	n	
				5.0E-05	I					1	0.1		Methamidophos	10265-92-6	3.2E+00	n	4.1E+01	n					1.0E+00	n		2.1E-04	n	
				2.0E+00	I	2.0E+01	I	V		1		1.1E+05	Methanol	67-56-1	1.2E+05	nms	1.2E+06	nms	2.1E+04	n	8.8E+04	n	2.0E+04	n		4.1E+00	n	
				1.5E-03	O					1	0.1		Methidathion	950-37-8	9.5E+01	n	1.2E+03	n					2.9E+01	n		7.1E-03	n	
				2.5E-02	I					1	0.1		Methomyl	16752-77-5	1.6E+03	n	2.1E+04	n					5.0E+02	n		1.1E-01	n	
4.9E-02	C	1.4E-05	C							1	0.1		Methoxy-5-nitroaniline, 2-	99-59-2	1.1E+01	c	4.7E+01	c	2.0E-01	c	8.8E-01	c	1.5E+00	c		5.3E-04	c	
				5.0E-03	I					1	0.1		Methoxychlor	72-43-5	3.2E+02	n	4.1E+03	n					3.7E+01	n	4.0E+01	2.0E+00	n	2.2E+00
				8.0E-03	P	1.0E-03	P	V		1		1.2E+05	Methoxyethanol Acetate, 2-	110-49-6	1.1E+02	n	5.1E+02	n	1.0E+00	n	4.4E+00	n	2.1E+00	n		4.2E-04	n	
				5.0E-03	P	2.0E-02	I	V		1		1.1E+05	Methoxyethanol, 2-	109-86-4	3.3E+02	n	3.5E+03	n	2.1E+01	n	8.8E+01	n	2.9E+01	n		6.9E-03	n	
				1.0E+00	X			V		1		2.9E+04	Methyl Acetate	79-20-9	7.8E+04	ns	1.2E+06	nms					2.0E+04	n		4.1E+00	n	
						2.0E-02	P	V		1		6.8E+03	Methyl Acrylate	96-33-3	1.5E+02	n	6.1E+02	n	2.1E+01	n	8.8E+01	n	4.2E+01	n		8.9E-03	n	
				6.0E-01	I	5.0E+00	I	V		1		2.8E+04	Methyl Ethyl Ketone (2-Butanone)	78-93-3	2.7E+04	n	1.9E+05	nms	5.2E+03	n	2.2E+04	n	5.6E+03	n		1.2E+00	n	
		1.0E-03	X	1.0E-03	P	2.0E-05	X	V		1		1.8E+05	Methyl Hydrazine	60-34-4	1.4E-01	c**	6.2E-01	c**	2.8E-03	c**	1.2E-02	c**	5.6E-03	c**		1.3E-06	c*	
						3.0E+00	I	V		1		3.4E+03	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	3.3E+04	ns	1.4E+05	nms	3.1E+03	n	1.3E+04	n	6.3E+03	n		1.4E+00	n	
						1.0E-03	C	V		1		1.0E+04	Methyl Isocyanate	624-83-9	4.6E+00	n	1.9E+01	n	1.0E+00	n	4.4E+00	n	2.1E+00	n		5.9E-04	n	
				1.4E+00	I	7.0E-01	I	V		1		2.4E+03	Methyl Methacrylate	80-62-6	4.4E+03	ns	1.9E+04	ns	7.3E+02	n	3.1E+03	n	1.4E+03	n		3.0E-01	n	
				2.5E-04	I					1	0.1		Methyl Parathion	298-00-0	1.6E+01	n	2.1E+02	n					4.5E+00	n		7.4E-03	n	
				6.0E-02	X					1	0.1		Methyl Phosphonic Acid	993-13-5	3.8E+03	n	4.9E+04	n					1.2E+03	n		2.4E-01	n	
				6.0E-03	H	4.0E-02	H	V		1		3.9E+02	Methyl Styrene (Mixed Isomers)	25013-15-4	3.2E+02	n	2.6E+03	ns	4.2E+01	n	1.8E+02	n	2.3E+01	n		3.8E-02	n	
9.9E-02	C	2.8E-05	C							1	0.1		Methyl methanesulfonate	66-27-3	5.5E+00	c	2.3E+01	c	1.0E-01	c	4.4E-01	c	7.9E-01	c		1.6E-04	c	
1.8E-03	C	2.6E-07	C			3.0E+00	I	V		1		8.9E+03	Methyl tert-Butyl Ether (MTBE)	1634-04-4	4.7E+01	c	2.1E+02	c	1.1E+01	c	4.7E+01	c	1.4E+01	c		3.2E-03	c	
				3.0E-04	X					1	0.1		Methyl-1,4-benzenediamine dihydrochloride, 2-	615-45-2	1.9E+01	n	2.5E+02	n					6.0E+00	n		3.8E-03	n	
9.0E-03	P			2.0E-02	X					1	0.1		Methyl-5-Nitroaniline, 2-	99-55-8	6.0E+01	c*	2.6E+02	c*					8.2E+00	c*		4.6E-03	c*	
8.3E+00	C	2.4E-03	C							1	0.1		Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	8.5E-02	c	2.8E-01	c	1.2E-03	c	5.1E-03	c	9.4E-03	c		3.2E-06	c	
1.3E-01	C	3.7E-05	C							1	0.1		Methylaniline Hydrochloride, 2-	636-21-5	4.2E+00	c	1.8E+01	c	7.6E-02	c	3.3E-01	c	6.0E-01	c		2.6E-04	c	
				1.0E-02	A					1	0.1		Methylarsonic acid	124-58-3	6.3E+02	n	8.2E+03	n					2.0E+02	n		5.8E-02	n	
				2.0E-04	X					1	0.1		Methylbenzene,1-4-diamine monohydrochloride, 2-	74612-12-7	1.3E+01	n	1.6E+02	n					4.0E+00	n			n	
1.0E-01	X			3.0E-04	X					1	0.1		Methylbenzene-1,4-diamine sulfate, 2-	615-50-9	5.4E+00	c**	2.3E+01	c*					7.8E-01	c**			c**	
2.2E+01	C	6.3E-03	C						M	1	0.1		Methylcholanthrene, 3-	56-49-5	5.5E-03	c	1.0E-01	c	1.6E-04	c	1.9E-03	c	1.1E-03	c		2.2E-03	c	
2.0E-03	I	1.0E-08	I	6.0E-03	I	6.0E-01	I	V	M	1		3.3E+03	Methylene Chloride	75-09-2	5.7E+01	c**	1.0E+03	c**	1.0E+02	c**	1.2E+03	c**	1.1E+01	c**	5.0E+00	2.9E-03	c**	1.3E-03
1.0E-01	P	4.3E-04	C	2.0E-03	P				M	1	0.1		Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	1.2E+00	c	2.3E+01	c*	2.4E-03	c	2.9E-02	c	1.6E-01	c		1.8E-03	c	

TR=1E-06
THQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information														Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
4.6E-02	I	1.3E-05	C							1	0.1		Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	101-61-1	1.2E+01	c	5.0E+01	c	2.2E-01	c	9.4E-01	c	4.8E-01	c		2.6E-03	c	
1.6E+00	C	4.6E-04	C			2.0E-02	C			1	0.1		Methylenebisbenzenamine, 4,4'-	101-77-9	3.4E-01	c	1.4E+00	c	6.1E-03	c	2.7E-02	c	4.7E-02	c		2.1E-04	c	
						6.0E-04	I			1	0.1		Methylenediphenyl Diisocyanate	101-68-8	8.5E+05	nm	3.6E+06	nm	6.3E-01	n	2.6E+00	n						
				7.0E-02	H			V		1		5.0E+02	Methylstyrene, Alpha-	98-83-9	5.5E+03	ns	8.2E+04	ns					7.8E+02	n		1.2E+00	n	
				1.5E-01	I					1	0.1		Metolachlor	51218-45-2	9.5E+03	n	1.2E+05	nm					2.7E+03	n		3.2E+00	n	
				2.5E-02	I					1	0.1		Metribuzin	21087-64-9	1.6E+03	n	2.1E+04	n					4.9E+02	n		1.5E-01	n	
				2.5E-01	I					1	0.1		Metsulfuron-methyl	74223-64-6	1.6E+04	n	2.1E+05	nm					4.9E+03	n		1.9E+00	n	
				3.0E+00	P			V		1		3.4E-01	Mineral oils	8012-95-1	2.3E+05	nms	3.5E+06	nms					6.0E+04	n		2.4E+03	n	
1.8E+01	C	5.1E-03	C	2.0E-04	I			V		1			Mirex	2385-85-5	3.6E-02	c	1.7E-01	c	5.5E-04	c	2.4E-03	c	8.8E-04	c		8.3E-04	c	
				2.0E-03	I					1	0.1		Molinate	2212-67-1	1.3E+02	n	1.6E+03	n					3.0E+01	n		1.7E-02	n	
				5.0E-03	I					1			Molybdenum	7439-98-7	3.9E+02	n	5.8E+03	n					1.0E+02	n		2.0E+00	n	
				1.0E-01	I					1			Monochloramine	10599-90-3	7.8E+03	n	1.2E+05	nm					2.0E+03	n	4.0E+03		n	
				2.0E-03	P					1	0.1		Monomethylaniline	100-61-8	1.3E+02	n	1.6E+03	n					3.8E+01	n		1.4E-02	n	
				2.5E-02	I					1	0.1		Myclobutanil	88671-89-0	1.6E+03	n	2.1E+04	n					4.5E+02	n		5.6E+00	n	
				3.0E-04	X					1	0.1		N,N'-Diphenyl-1,4-benzenediamine	74-31-7	1.9E+01	n	2.5E+02	n					3.6E+00	n		3.7E-01	n	
				2.0E-03	I			V		1			Naled	300-76-5	1.6E+02	n	2.3E+03	n					4.0E+01	n		1.8E-02	n	
				3.0E-02	X	1.0E-01	P	V		1			Naphtha, High Flash Aromatic (HFAN)	64742-95-6	2.3E+03	n	3.5E+04	n	1.0E+02	n	4.4E+02	n	1.5E+02	n			n	
1.8E+00	C	0.0E+00	C							1	0.1		Naphthylamine, 2-	91-59-8	3.0E-01	c	1.3E+00	c					3.9E-02	c		2.0E-04	c	
				1.2E-01	O					1	0.1		Napropamide	15299-99-7	7.6E+03	n	9.8E+04	n					2.0E+03	n		1.3E+01	n	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			1	0.1		Nickel Acetate	373-02-4	6.7E+02	n	8.1E+03	n	1.1E-02	c**	4.7E-02	c**	2.2E+02	n		4.5E-02	n	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			1	0.1		Nickel Carbonate	3333-67-3	6.7E+02	n	8.1E+03	n	1.1E-02	c**	4.7E-02	c**	2.2E+02	n			n	
		2.6E-04	C	1.1E-02	C	1.4E-05	C	V		1			Nickel Carbonyl	13463-39-3	8.2E+02	n	1.1E+04	n	1.1E-02	c**	4.7E-02	c**	2.2E-02	c**			c**	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			0.04			Nickel Hydroxide	12054-48-7	8.2E+02	n	1.1E+04	n	1.1E-02	c**	4.7E-02	c**	2.0E+02	n			n	
		2.6E-04	C	1.1E-02	C	2.0E-05	C			0.04			Nickel Oxide	1313-99-1	8.4E+02	n	1.2E+04	n	1.1E-02	c**	4.7E-02	c**	2.0E+02	n			n	
		2.4E-04	I	1.1E-02	C	1.4E-05	C			0.04			Nickel Refinery Dust	E715532	8.2E+02	n	1.1E+04	n	1.2E-02	c**	5.1E-02	c**	2.2E+02	n		3.2E+01	n	
		2.6E-04	C	2.0E-02	I	9.0E-05	A			0.04			Nickel Soluble Salts	7440-02-0	1.5E+03	n	2.2E+04	n	1.1E-02	c**	4.7E-02	c**	3.9E+02	n		2.6E+01	n	
1.7E+00	C	4.8E-04	I	1.1E-02	C	1.4E-05	C			0.04			Nickel Subsulfide	12035-72-2	4.1E-01	c	1.9E+00	c	5.8E-03	c**	2.6E-02	c**	4.5E-02	c			c	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			1	0.1		Nickelocene	1271-28-9	6.7E+02	n	8.1E+03	n	1.1E-02	c**	4.7E-02	c**	2.2E+02	n			n	
				1.6E+00	I					1			Nitrate	14797-55-8	1.3E+05	nm	1.9E+06	nm					3.2E+04	n	1.0E+04		n	
										1			Nitrate + Nitrite (as N)	E701177											1.0E+04			
				1.0E-01	I					1			Nitrite	14797-65-0	7.8E+03	n	1.2E+05	nm					2.0E+03	n	1.0E+03		n	
				1.0E-02	X	5.0E-05	X			1	0.1		Nitroaniline, 2-	88-74-4	6.3E+02	n	8.0E+03	n	5.2E-02	n	2.2E-01	n	1.9E+02	n		8.0E-02	n	
2.0E-02	P			4.0E-03	P	6.0E-03	P			1	0.1		Nitroaniline, 4-	100-01-6	2.7E+01	c**	1.1E+02	c*	6.3E+00	n	2.6E+01	n	3.8E+00	c*		1.6E-03	c*	
		4.0E-05	I	2.0E-03	I	9.0E-03	I	V		1		3.1E+03	Nitrobenzene	98-95-3	5.1E+00	c*	2.2E+01	c*	7.0E-02	c	3.1E-01	c	1.4E-01	c*		9.2E-05	c*	
				3.0E+03	P					1	0.1		Nitrocellulose	9004-70-0	1.9E+08	nm	2.5E+09	nm					6.0E+07	n		1.3E+04	n	
				7.0E-02	H					1	0.1		Nitrofurantoin	67-20-9	4.4E+03	n	5.7E+04	n					1.4E+03	n		6.1E-01	n	
1.3E+00	C	3.7E-04	C							1	0.1		Nitrofurazone	59-87-0	4.2E-01	c	1.8E+00	c	7.6E-03	c	3.3E-02	c	6.0E-02	c		5.4E-05	c	
1.7E-02	P			1.0E-04	P					1	0.1		Nitroglycerin	55-63-0	6.3E+00	n	8.2E+01	n					2.0E+00	n		8.5E-04	n	
				1.0E-01	I					1	0.1		Nitroguanidine	556-88-7	6.3E+03	n	8.2E+04	n					2.0E+03	n		4.9E-01	n	
		8.8E-06	P			5.0E-03	P	V		1		1.8E+04	Nitromethane	75-52-5	5.4E+00	c*	2.4E+01	c*	3.2E-01	c*	1.4E+00	c*	6.4E-01	c*		1.4E-04	c*	
		2.7E-03	H			2.0E-02	I	V		1		4.9E+03	Nitropropane, 2-	79-46-9	1.4E-02	c	6.0E-02	c	1.0E-03	c	4.5E-03	c	2.1E-03	c		5.4E-07	c	
2.7E+01	C	7.7E-03	C						M	1	0.1		Nitroso-N-ethylurea, N-	759-73-9	4.5E-03	c	8.5E-02	c	1.3E-04	c	1.6E-03	c	9.2E-04	c		2.2E-07	c	
1.2E+02	C	3.4E-02	C						M	1	0.1		Nitroso-N-methylurea, N-	684-93-5	1.0E-03	c	1.9E-02	c	3.0E-05	c	3.6E-04	c	1.1E-02	c		4.6E-08	c	
5.4E+00	I	1.6E-03	I					V		1			Nitroso-di-N-butylamine, N-	924-16-3	9.9E-02	c	4.6E-01	c	1.8E-03	c	7.7E-03	c	2.7E-03	c		5.5E-06	c	
7.0E+00	I	2.0E-03	C							1	0.1		Nitroso-di-N-propylamine, N-	621-64-7	7.8E-02	c	3.3E-01	c	1.4E-03	c	6.1E-03	c	1.1E-02	c		8.1E-06	c	
2.8E+00	I	8.0E-04	C							1	0.1		Nitrosodiethanolamine, N-	1116-54-7	1.9E-01	c	8.2E-01	c	3.5E-03	c	1.5E-02	c	2.8E-02	c		5.6E-06	c	
1.5E+02	I	4.3E-02	I						M	1	0.1		Nitrosodiethylamine, N-	55-18-5	8.1E-04	c	1.5E-02	c	2.4E-05	c	2.9E-04	c	1.7E-04	c		6.1E-09	c	
5.1E+01	I	1.4E-02	I	8.0E-06	P	4.0E-05	X	V	M	1		2.4E+05	Nitrosodimethylamine, N-	62-75-9	2.0E-03	c	3.4E-02	c	7.2E-05	c	8.8E-04	c	1.1E-04	c		2.7E-08	c	
4.9E-03	I	2.6E-06	C							1	0.1		Nitrosodiphenylamine, N-	86-30-6	1.1E+02	c	4.7E+02	c	1.1E+00	c	4.7E+00	c	1.2E+01	c		6.7E-02	c	
2.2E+01	I	6.3E-03	C					V		1		1.1E+05	Nitrosomethylethylamine, N-	10595-95-6	2.0E-02	c	9.1E-02	c	4.5E-04	c	1.9E-03	c	7.1E-04	c		2.0E-07	c	
6.7E+00	C	1.9E-03	C							1	0.1		Nitrosomorpholine [N-]	59-89-2	8.1E-02	c	3.4E-01	c	1.5E-03	c	6.5E-03	c	1.2E-02	c		2.8E-06	c	
9.4E+00	C	2.7E-03	C							1	0.1		Nitrosopiperidine [N-]	100-75-4	5.8E-02	c	2.4E-01	c	1.0E-03	c	4.5E-03	c	8.2E-03	c		4.4E-06	c	
2.1E+00	I	6.1E-04	I							1	0.1		Nitrosopyrrolidine, N-	930-55-2	2.6E-01	c	1.1E+00	c	4.6E-03	c	2.0E-02	c	3.7E-02	c		1.4E-05	c	
				1.0E-04	X					1	0.1		Nitrotoluene, m-	99-08-1	6.3E+00	n	8.2E+01	n					1.7E+00	n		1.6E-03	n	
2.2E-01	P			9.0E-04	P			V		1		1.5E+03	Nitrotoluene, o-	88-72-2	3.2E+00	c*	1.5E+01	c*					3.1E-01	c*		3.0E-04	c*	
1.6E-02	P			4.0E-03	P					1	0.1		Nitrotoluene, p-	99-99-0	3.4E+01	c**	1.4E+02	c*					4.3E+00	c*		4.0E-03	c*	
				3.0E-04	X	2.0E-02	P	V		1		6.9E+00	Nonane, n-	111-84-2	1.1E+01	ns	7.2E+01	ns	2.1E+01	n	8.8E+01	n	5.3E+00	n		7.5E-02	n	
				1.5E-02	O					1	0.1		Norflurazon	27314-13-2	9.5E+02	n	1.2E+04	n					2.9E+02	n		1.9E+00	n	
				3.0E-03	I					1	0.1		Octabromodiphenyl Ether	32536-52-0	1.9E+02	n	2.5E+03	n					6.0E+01	n		1.2E+01	n	
				5.0E-02	I					1	0.006		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	3.9E+03	n	5.7E+04	n					1.0E+03	n		1.3E+00	n	
				2.0E-03	H					1	0.1		Octamethylpyrophosphoramide	152-16-9	1.3E+02	n	1.6E+03	n					4.0E+01	n		5.6E-03	n	
7.8E-03	O			1.4E-01	O					1	0.1		Oryzalin	19044-88-3	7.0E+01	c	2.9E+02	c					7.9E+00	c		1.5E-02	c	
				5.0E-03	I					1	0.1		Oxadiazon	19666-30-9	3.2E+02	n	4.1E+03	n					4.7E+01	n		4.8E-01	n	
				2.5E-02	I					1	0.1		Oxamyl	23135-22-0	1.6E+03	n	2.1E+04	n					5.0E+02	n	2.0E+02	1.1E-01	n	4.4E-02
7.3E-02	O			3.0E-02	O					1	0.1		Oxyfluorfen	42874-03-3	7.4E+00	c	3.1E+01	c					5.4E-01	c		4.3E-02	c	
				1.3E-02	I					1	0.1		Paclobutrazol	76738-62-0	8.2E+02	n	1.1E+04	n					2.3E+02	n		4.6E-01	n	
				4.5E-03	I					1	0.1		Paraquat Dichloride	1910-42-5	2.8E+02	n	3.7E+03	n					9.0E+01	n		1.2E+00	n	
				6.0E-03	H					1	0.1		Parathion	56-38-2	3.8E+02	n	4.9E+03	n					8.6E+01	n		4.3E-01	n	
				5.0E-02	H			V		1			Pebulate	1114-71-2	3.9E+03	n	5.8E+04	n					5.6E+02	n		4.5E-01	n	
				3.0E-02	O					1	0.1		Pendimethalin	40487-42-1	1.9E+03	n	2.5E+04	n					1.4E+02	n		1.6E+00	n	
				2.0E-03	I			V		1		3.1E-01	Pentabromodiphenyl Ether	32534-81-9	1.6E+02	ns	2.3E+03	ns					4.0E+01	n		1.7E+00	n	
				1.0E-04	I					1	0.1		Pentabromodiphenyl ether, 2,2',4,4',5- (BDE-99)	60348-60-9	6.3E+00	n	8.2E+01	n					2.0E+00	n		8.7E-03	n	
				8.0E-04	I			V		1			Pentachlorobenzene	608-93-5	6.3E+01	n	9.3E+02	n					3.2E+00	n		2.4E-02	n	
9.0E-02	P							V		1		4.6E+02	Pentachloroethane	76-01-7	7.7E+00	c	3.6E+01	c					6.5E-01	c		3.1E-04	c	
2.6E-01	H			3.0E-03	I			V		1			Pentachloronitrobenzene	82-68-8	2.7E+00	c*	1.3E+01	c					1.2E-01	c		1.5E-03	c	
4.0E-01	I	5.1E-06	C	5.0E-03	I					1	0.25		Pentachlorophenol	87-86-5	1.0E+00	c	4.0E+00	c	5.5E-01	c	2.4E+00	c	4.1E-02	c	1.0E+00	5.7E-05	c	1.4E-03

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information													Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
4.0E-03		X		2.0E-03	P					1	0.1		Pentaerythritol tetranitrate (PETN)	78-11-5	1.3E+02	n	5.7E+02	c**					1.9E+01	c**		2.8E-02	c**	
						1.0E+00	P	V		1		3.9E+02	Pentane, n-	109-66-0	8.1E+02	ns	3.4E+03	ns	1.0E+03	n	4.4E+03	n	2.1E+03	n		1.0E+01	n	
													Perchlorates																
				7.0E-04	I					1			~Ammonium Perchlorate	7790-98-9	5.5E+01	n	8.2E+02	n					1.4E+01	n			n	
				7.0E-04	I					1			~Lithium Perchlorate	7791-03-9	5.5E+01	n	8.2E+02	n					1.4E+01	n			n	
				7.0E-04	I					1			~Perchlorate and Perchlorate Salts	14797-73-0	5.5E+01	n	8.2E+02	n					1.4E+01	n	1.5E+01(F)		n	
				7.0E-04	I					1			~Potassium Perchlorate	7778-74-7	5.5E+01	n	8.2E+02	n					1.4E+01	n			n	
				7.0E-04	I					1			~Sodium Perchlorate	7601-89-0	5.5E+01	n	8.2E+02	n					1.4E+01	n			n	
				2.0E-02	P					1	0.1		Perfluorobutane sulfonic acid (PFBS)	375-73-5	1.3E+03	n	1.6E+04	n					4.0E+02	n		1.3E-01	n	
				2.0E-02	P					1	0.1		Perfluorobutanesulfonate	45187-15-3	1.3E+03	n	1.6E+04	n					4.0E+02	n		1.3E-01	n	
				5.0E-02	I					1	0.1		Permethrin	52645-53-1	3.2E+03	n	4.1E+04	n					1.0E+03	n		2.4E+02	n	
2.2E-03		C	6.3E-07	C						1	0.1		Phenacetin	62-44-2	2.5E+02	c	1.0E+03	c	4.5E+00	c	1.9E+01	c	3.4E+01	c		9.7E-03	c	
				2.4E-01	O					1	0.1		Phenmedipham	13684-63-4	1.5E+04	n	2.0E+05	nm					3.8E+03	n		2.1E+01	n	
				3.0E-01	I	2.0E-01	C			1	0.1		Phenol	108-95-2	1.9E+04	n	2.5E+05	nm	2.1E+02	n	8.8E+02	n	5.8E+03	n		3.3E+00	n	
				4.0E-03	I					1	0.1		Phenol, 2-(1-methylethoxy)-, methylcarbamate	114-26-1	2.5E+02	n	3.3E+03	n					7.8E+01	n		2.5E-02	n	
				5.0E-04	X					1	0.1		Phenothiazine	92-84-2	3.2E+01	n	4.1E+02	n					4.3E+00	n		1.4E-02	n	
				2.0E-04	X			V		1		1.3E+02	Phenyl Isothiocyanate	103-72-0	1.6E+01	n	2.3E+02	ns					2.6E+00	n		1.7E-03	n	
				6.0E-03	I					1	0.1		Phenylenediamine, m-	108-45-2	3.8E+02	n	4.9E+03	n					1.2E+02	n		3.2E-02	n	
1.2E-01		P		4.0E-03	P					1	0.1		Phenylenediamine, o-	95-54-5	4.5E+00	c*	1.9E+01	c					6.5E-01	c		1.7E-04	c	
				1.0E-03	X					1	0.1		Phenylenediamine, p-	106-50-3	6.3E+01	n	8.2E+02	n					2.0E+01	n		5.4E-03	n	
1.9E-03		H								1	0.1		Phenylphenol, 2-	90-43-7	2.8E+02	c	1.2E+03	c					3.0E+01	c		4.1E-01	c	
				2.0E-04	H					1	0.1		Phorate	298-02-2	1.3E+01	n	1.6E+02	n					3.0E+00	n		2.4E-03	n	
						3.0E-04	I	V		1		1.6E+03	Phosgene	75-44-5	3.1E-01	n	1.3E+00	n	3.1E-01	n	1.3E+00	n						
				2.0E-02	I					1	0.1		Phosmet	732-11-6	1.3E+03	n	1.6E+04	n					3.7E+02	n		8.2E-02	n	
													Phosphates, Inorganic																
				4.9E+01	P					1			~Aluminum metaphosphate	13776-88-0	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Ammonium polyphosphate	68333-79-9	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Calcium pyrophosphate	7790-76-3	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Diammonium phosphate	7783-28-0	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Dicalcium phosphate	7757-93-9	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Dimagnesium phosphate	7782-75-4	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Dipotassium phosphate	7758-11-4	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Disodium phosphate	7558-79-4	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Monoaluminum phosphate	13530-50-2	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Monoammonium phosphate	7722-76-1	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Monocalcium phosphate	7758-23-8	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Monomagnesium phosphate	7757-86-0	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Monopotassium phosphate	7778-77-0	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Monosodium phosphate	7558-80-7	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Polyphosphoric acid	8017-16-1	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Potassium tripolyphosphate	13845-36-8	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium acid pyrophosphate	7758-16-9	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium aluminum phosphate (acid)	7785-88-8	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium aluminum phosphate (anhydrous)	10279-59-1	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium aluminum phosphate (tetrahydrate)	10305-76-7	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium hexametaphosphate	10124-56-8	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium polyphosphate	68915-31-1	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium trimetaphosphate	7785-84-4	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Sodium tripolyphosphate	7758-29-4	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Tetrapotassium phosphate	7320-34-5	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Tetrasodium pyrophosphate	7722-88-5	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Trialuminum sodium tetra decahydrogenoctaorthophosphate (dihydrate)	15136-87-5	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Tricalcium phosphate	7758-87-4	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Trimagnesium phosphate	7757-87-1	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Tripotassium phosphate	7778-53-2	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				4.9E+01	P					1			~Trisodium phosphate	7601-54-9	3.8E+06	nm	5.7E+07	nm					9.7E+05	n			n	
				3.0E-04	I	3.0E-04	I	V		1			Phosphine	7803-51-2	2.3E+01	n	3.5E+02	n	3.1E-01	n	1.3E+00	n	5.7E-01	n			n	
				4.9E+01	P	1.0E-02	I			1			Phosphoric Acid	7664-38-2	3.0E+06	nm	2.9E+07	nm	1.0E+01	n	4.4E+01	n	9.7E+05	n			n	
				2.0E-05	I			V		1			Phosphorus, White	7723-14-0	1.6E+00	n	2.3E+01	n					4.0E-01	n		1.5E-03	n	
													Phthalates																
1.4E-02		I	2.4E-06	C	2.0E-02	I				1	0.1		~Bis(2-ethylhexyl)phthalate	117-81-7	3.9E+01	c*	1.6E+02	c	1.2E+00	c	5.1E+00	c	5.6E+00	c*	6.0E+00	1.3E+00	c*	1.4E+00
1.9E-03		P		2.0E-01	I					1	0.1		~Butyl Benzyl Phthalate	85-68-7	2.9E+02	c*	1.2E+03	c					1.6E+01	c		2.4E-01	c	
				1.0E+00	I					1	0.1		~Butylphthalyl Butylglycolate	85-70-1	6.3E+04	n	8.2E+05	nm					1.3E+04	n		3.1E+02	n	
				1.0E-01	I					1	0.1		~Dibutyl Phthalate	84-74-2	6.3E+03	n	8.2E+04	n					9.0E+02	n		2.3E+00	n	
				8.0E-01	I					1	0.1		~Diethyl Phthalate	84-66-2	5.1E+04	n	6.6E+05	nm					1.5E+04	n		6.1E+00	n	
				1.0E-01	I			V		1			~Dimethylterephthalate	120-61-6	7.8E+03	n	1.2E+05	nm					1.9E+03	n		4.9E-01	n	
				1.0E-02	P					1	0.1		~Octyl Phthalate, di-N-	117-84-0	6.3E+02	n	8.2E+03	n					2.0E+02	n		5.7E+01	n	
				1.0E+00	H					1	0.1		~Phthalic Acid, P-	100-21-0	6.3E+04	n	8.2E+05	nm					1.9E+04	n		6.9E+00	n	
				2.0E+00	I	2.0E-02	C			1	0.1		~Phthalic Anhydride	85-44-9	1.3E+05	nm	1.6E+06	nm	2.1E+01	n	8.8E+01	n	3.9E+04	n		8.5E+00	n	
				7.0E-02	I					1	0.1		Picloram	1918-02-1	4.4E+03	n	5.7E+04	n					1.4E+03	n	5.0E+02	3.9E-01	n	1.4E-01
				1.0E-04	X					1	0.1		Picramic Acid (2-Amino-4,6-dinitrophenol)	96-91-3	6.3E+00	n	8.2E+01	n					2.0E+00	n		1.3E-03	n	
				9.0E-04	X					1	0.1		Picric Acid (2,4,6-Trinitrophenol)	88-89-1	5.7E+01	n	7.4E+02	n					1.8E+01	n		8.4E-02	n	
				6.7E-05	O					1	0.1		Pirimiphos, Methyl	29232-93-7	4.2E+00	n	5.5E+01	n					8.1E-01	n		7.7E-04	n	
3.0E+01		C	8.6E-03	C	7.0E-06	H				1	0.1		Polybrominated Biphenyls	59536-65-1	1.8E-02	c*	7.7E-02	c*	3.3E-04	c	1.4E-03	c	2.6E-03	c*			c*	
													Polychlorinated Biphenyls (PCBs)																
7.0E-02		S	2.0E-05	S	7.0E-05	I		V		1	0.14		~Aroclor 1016	12674-11-2	4.1E+00	n	2.7E+01	c**	1.4E-01	c	6.1E-01	c	2.2E-01	c**		2.1E-02	c**	

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PRRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information															Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD$_o$ (mg/kg-day)	key	RfC$_i$ (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C$_{sat}$ (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)	
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1221	11104-28-2	2.0E-01	c	8.3E-01	c	4.9E-03	c	2.1E-02	c	4.7E-03	c		8.0E-05	c		
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1232	11141-16-5	1.7E-01	c	7.2E-01	c	4.9E-03	c	2.1E-02	c	4.7E-03	c		8.0E-05	c		
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1242	53469-21-9	2.3E-01	c	9.5E-01	c	4.9E-03	c	2.1E-02	c	7.8E-03	c		1.2E-03	c		
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1248	12672-29-6	2.3E-01	c	9.5E-01	c	4.9E-03	c	2.1E-02	c	7.8E-03	c		1.2E-03	c		
2.0E+00	S	5.7E-04	S	2.0E-05	I			V		1	0.14		~Aroclor 1254	11097-69-1	2.4E-01	c**	9.7E-01	c*	4.9E-03	c	2.1E-02	c	7.8E-03	c*		2.0E-03	c*		
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1260	11096-82-5	2.4E-01	c	9.9E-01	c	4.9E-03	c	2.1E-02	c	7.8E-03	c		5.5E-03	c		
				6.0E-04	X			V		1	0.14		~Aroclor 5460	11126-42-4	3.5E+01	n	4.4E+02	n					1.2E+01	n		2.0E+00	n		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)	39635-31-9	1.3E-01	c*	5.2E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		2.8E-03	c		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)	52663-72-6	1.2E-01	c*	5.1E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		1.7E-03	c		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5'- (PCB 157)	69782-90-7	1.2E-01	c*	5.0E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		1.7E-03	c		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5,- (PCB 156)	38380-08-4	1.2E-01	c*	5.0E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		1.7E-03	c		
3.9E+03	E	1.1E+00	E	2.3E-08	E	1.3E-06	E	V		1	0.14		~Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)	32774-16-6	1.2E-04	c*	5.1E-04	c*	2.5E-06	c	1.1E-05	c	4.0E-06	c		1.7E-06	c		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2',3,4,4',5- (PCB 123)	65510-44-3	1.2E-01	c*	4.9E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		1.0E-03	c		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)	31508-00-6	1.2E-01	c*	4.9E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		1.0E-03	c		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)	32598-14-4	1.2E-01	c*	4.9E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		1.0E-03	c		
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)	74472-37-0	1.2E-01	c*	5.0E-01	c*	2.5E-03	c	1.1E-02	c	4.0E-03	c		1.0E-03	c		
1.3E+04	E	3.8E+00	E	7.0E-09	E	4.0E-07	E	V		1	0.14		~Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)	57465-28-8	3.6E-05	c*	1.5E-04	c*	7.4E-07	c	3.2E-06	c	1.2E-06	c		3.0E-07	c		
2.0E+00	I	5.7E-04	I					V		1	0.14		~Polychlorinated Biphenyls (high risk)	1336-36-3	2.3E-01	c	9.4E-01	c	4.9E-03	c	2.1E-02	c			5.0E-01				
4.0E-01	I	1.0E-04	I					V		1	0.14		~Polychlorinated Biphenyls (low risk)	1336-36-3					2.8E-02	c	1.2E-01	c	4.4E-02	c	5.0E-01	6.8E-03	c	7.8E-02	
7.0E-02	I	2.0E-05	I					V		1	0.14		~Polychlorinated Biphenyls (lowest risk)	1336-36-3					1.4E-01	c	6.1E-01	c			5.0E-01				
1.3E+01	E	3.8E-03	E	7.0E-06	E	4.0E-04	E			1	0.14		~Tetrachlorobiphenyl, 3,3',4,4'- (PCB 77)	32598-13-3	3.8E-02	c*	1.6E-01	c*	7.4E-04	c	3.2E-03	c	6.0E-03	c*		9.4E-04	c*		
3.9E+01	E	1.1E-02	E	2.3E-06	E	1.3E-04	E	V		1	0.14		~Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)	70362-50-4	1.2E-02	c*	4.8E-02	c*	2.5E-04	c	1.1E-03	c	4.0E-04	c		8.2E-05	c		
						6.0E-04	I			1	0.1		Polymeric Methylene Diphenyl Diisocyanate (PMDI)	9016-87-9	8.5E+05	nm	3.6E+06	nm	6.3E-01	n	2.6E+00	n							
													Polynuclear Aromatic Hydrocarbons (PAHs)																	
				6.0E-02	I			V		1	0.13		~Acenaphthene	83-32-9	3.6E+03	n	4.5E+04	n					5.3E+02	n		5.5E+00	n		
				3.0E-01	I			V		1	0.13		~Anthracene	120-12-7	1.8E+04	n	2.3E+05	nm					1.8E+03	n		5.9E+01	n		
1.0E-01	E	6.0E-05	E					V	M	1	0.13		~Benz[a]anthracene	56-55-3	1.1E+00	c	2.1E+01	c	1.7E-02	c	2.0E-01	c	3.0E-02	c		1.1E-02	c		
1.2E+00	C	1.1E-04	C							1	0.13		~Benzo(j)fluoranthene	205-82-3	4.2E-01	c	1.8E+00	c	2.6E-02	c	1.1E-01	c	6.5E-02	c		7.6E-02	c		
1.0E+00	I	6.0E-04	I	3.0E-04	I	2.0E-06	I		M	1	0.13		~Benzo[a]pyrene	50-32-8	1.1E-01	c	2.1E+00	c	1.7E-03	c**	8.8E-03	n	2.5E-02	c	2.0E-01	2.8E-02	c	2.4E-01	
1.0E-01	E	6.0E-05	E						M	1	0.13		~Benzo[b]fluoranthene	205-99-2	1.1E+00	c	2.1E+01	c	1.7E-02	c	2.0E-01	c	2.5E-01	c		2.0E-01	c		
1.0E-02	E	6.0E-06	E						M	1	0.13		~Benzo[k]fluoranthene	207-08-9	1.1E+01	c	2.1E+02	c	1.7E-01	c	2.0E+00	c	2.5E+00	c		2.9E+00	c		
				8.0E-02	I			V		1	0.13		~Chloronaphthalene, Beta-	91-58-7	4.8E+03	n	6.0E+04	n					7.5E+02	n		3.9E+00	n		
1.0E-03	E	6.0E-07	E						M	1	0.13		~Chrysene	218-01-9	1.1E+02	c	2.1E+03	c	1.7E+00	c	2.0E+01	c	2.5E+01	c		9.0E+00	c		
1.0E+00	E	6.0E-04	E						M	1	0.13		~Dibenz[a,h]anthracene	53-70-3	1.1E-01	c	2.1E+00	c	1.7E-03	c	2.0E-02	c	2.5E-02	c		9.6E-02	c		
1.2E+01	C	1.1E-03	C							1	0.13		~Dibenzo(a,e)pyrene	192-65-4	4.2E-02	c	1.8E-01	c	2.6E-03	c	1.1E-02	c	6.5E-03	c		8.4E-02	c		
2.5E+02	C	7.1E-02	C						M	1	0.13		~Dimethylbenz[a]anthracene, 7,12-	57-97-6	4.6E-04	c	8.4E-03	c	1.4E-05	c	1.7E-04	c	1.0E-04	c		9.9E-05	c		
				4.0E-02	I					1	0.13		~Fluoranthene	206-44-0	2.4E+03	n	3.0E+04	n					8.0E+02	n		8.9E+01	n		
				4.0E-02	I			V		1	0.13		~Fluorene	86-73-7	2.4E+03	n	3.0E+04	n					2.9E+02	n		5.4E+00	n		
1.0E-01	E	6.0E-05	E						M	1	0.13		~Indeno[1,2,3-cd]pyrene	193-39-5	1.1E+00	c	2.1E+01	c	1.7E-02	c	2.0E-01	c	2.5E-01	c		9.8E-01	c		
2.9E-02	P			7.0E-02	A			V		1	0.13	3.9E+02	~Methylnaphthalene, 1-	90-12-0	1.8E+01	c	7.3E+01	c					1.1E+00	c		8.0E-03	c		
				4.0E-03	I			V		1	0.13		~Methylnaphthalene, 2-	91-57-6	2.4E+02	n	3.0E+03	n					3.6E+01	n		1.9E-01	n		
		3.4E-05	C	2.0E-02	I	3.0E-03	I	V		1	0.13		~Naphthalene	91-20-3	3.8E+00	c*	1.7E+01	c*	8.3E-02	c*	3.6E-01	c*	1.7E-01	c*		5.4E-04	c*		
1.2E+00	C	1.1E-04	C							1	0.13		~Nitropyrene, 4-	57835-92-4	4.2E-01	c	1.8E+00	c	2.6E-02	c	1.1E-01	c	1.9E-02	c		3.3E-03	c		
				3.0E-02	I			V		1	0.13		~Pyrene	129-00-0	1.8E+03	n	2.3E+04	n					1.2E+02	n		1.3E+01	n		
				2.0E-02	P					1	0.1		Potassium Perfluorobutane Sulfonate	29420-49-3	1.3E+03	n	1.6E+04	n					4.0E+02	n			n		
1.5E-01	I			9.0E-03	I					1	0.1		Prochloraz	67747-09-5	3.6E+00	c	1.5E+01	c					3.8E-01	c		1.9E-03	c		
				6.0E-03	H			V		1			Profluralin	26399-36-0	4.7E+02	n	7.0E+03	n					2.6E+01	n		1.6E+00	n		
				1.5E-02	I					1	0.1		Prometon	1610-18-0	9.5E+02	n	1.2E+04	n					2.5E+02	n		1.2E-01	n		
				4.0E-02	O					1	0.1		Prometryn	7287-19-6	2.5E+03	n	3.3E+04	n					6.0E+02	n		9.0E-01	n		
				1.3E-02	I					1	0.1		Propachlor	1918-16-7	8.2E+02	n	1.1E+04	n					2.5E+02	n		1.5E-01	n		
				5.0E-03	I					1	0.1		Propanil	709-98-8	3.2E+02	n	4.1E+03	n					8.2E+01	n		4.9E-02	n		
3.3E-02	O			4.0E-02	O					1	0.1		Propargite	2312-35-8	1.7E+01	c	7.0E+01	c					9.2E-01	c		5.8E-02	c		
				2.0E-03	I			V		1		1.1E+05	Propargyl Alcohol	107-19-7	1.6E+02	n	2.3E+03	n					4.0E+01	n		8.1E-03	n		
				2.0E-02	I					1	0.1		Propazine	139-40-2	1.3E+03	n	1.6E+04	n					3.4E+02	n		2.0E-01	n		
				2.0E-02	I					1	0.1		Propham	122-42-9	1.3E+03	n	1.6E+04	n					3.5E+02	n		2.2E-01	n		
				1.0E-01	O					1	0.1		Propiconazole	60207-90-1	6.3E+03	n	8.2E+04	n					1.6E+03	n		5.3E+00	n		
						8.0E-03	I	V		1		3.3E+04	Propionaldehyde	123-38-6	7.5E+01	n	3.1E+02	n	8.3E+00	n	3.5E+01	n	1.7E+01	n		3.4E-03	n		
				1.0E-01	X	1.0E+00	X	V		1		2.6E+02	Propyl benzene	103-65-1	3.8E+03	ns	2.4E+04	ns	1.0E+03	n	4.4E+03	n	6.6E+02	n		1.2E+00	n		
						3.0E+00	C	V		1		3.5E+02	Propylene	115-07-1	2.2E+03	ns	9.3E+03	ns	3.1E+03	n	1.3E+04	n	6.3E+03	n		8.0E+00	n		
				2.0E+01	P					1	0.1		Propylene Glycol	57-55-6	1.3E+06	nm	1.6E+07	nm					4.0E+05	n		8.1E+01	n		
						2.7E-04	A			1	0.1		Propylene Glycol Dinitrate	6423-43-4	3.9E+05	nm	1.6E+06	nm	2.8E-01	n	1.2E+00	n							
				7.0E-01	H	2.0E+00	I	V		1		1.1E+05	Propylene Glycol Monomethyl Ether	107-98-2	4.1E+04	n	3.7E+05	nms	2.1E+03	n	8.8E+03	n	3.2E+03	n		6.5E-01	n		
2.4E-01	I	3.7E-06	I			3.0E-02	I	V		1		7.8E+04	Propylene Oxide	75-56-9	2.1E+00	c	9.7E+00	c	7.6E-01	c*	3.3E+00	c*	2.7E-01	c		5.6E-05	c		
				7.5E-02	I					1	0.1		Propyzamide	23950-58-5	4.7E+03	n	6.2E+04	n					1.2E+03	n		1.2E+00	n		
				1.0E-03	I			V		1		5.3E+05	Pyridine	110-86-1	7.8E+01	n	1.2E+03	n					2.0E+01	n		6.8E-03	n		
				5.0E-04	I					1	0.1		Quinalphos	13593-03-8	3.2E+01	n	4.1E+02	n					5.1E+00	n		4.3E-02	n		
3.0E+00	I									1	0.1		Quinoline	91-22-5	1.8E-01	c	7.7E-01	c					2.4E-02	c		7.8E-05	c		
				9.0E-03	I					1	0.1		Quizalofop-ethyl	76578-14-8	5.7E+02	n	7.4E+03	n					1.2E+02	n		1.9E+00	n		
						3.0E-02	A			1			Refractory Ceramic Fibers	E715557	4.3E+07	nm	1.8E+08	nm	3.1E+01	n	1.3E+02	n							
				3.0E-02	I					1	0.1		Resmethrin	10453-86-8	1.9E+03	n	2.5E+04	n					6.7E+01	n		4.2E+01	n		
				5.0E-02	H			V		1			Ronnel	299-84-3	3.9E+03	n	5.8E+04	n					4.1E+02	n		3.7E+00	n		
				4.0E-03	I					1	0.1		Rotenone	83-79-4	2.5E+02	n	3.3E+03	n					6.1E+01	n		3.2E+01	n		
2.2E-01	C	6.3E-05	C						M	1	0.1		Safrole	94-59-7	5.5E-01	c	1.0E+01	c	1.6E-02	c	1.9E-01	c	9.6E-02	c		5.8E-05	c		
				5.0E-03	I					1			Selenious Acid	7783-00-8	3.9E+02	n	5.8E+03	n					1.0E+02	n			n		
				5.0E-03	I	2.0E-02	C			1			Selenium	7782-49-2	3.9E+02	n	5.8E+03	n	2.1E+01	n	8.8E+01	n	1.0E+02	n	5.0E+01	5.2E-01	n	2.6E-01	
				5.0E-03	C	2.0E-02	C			1			Selenium Sulfide	7446-34-6	3.9E+02	n	5.8E+03	n	2.1E+01	n	8.8E+01	n	1.0E+02	n			n		

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information														Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				1.4E-01	O					1	0.1		Sethoxydim	74051-80-2	8.8E+03	n	1.1E+05	nm					1.6E+03	n		1.4E+01	n		
						3.0E-03	C			1			Silica (crystalline, respirable)	7631-86-9	4.3E+06	nm	1.8E+07	nm	3.1E+00	n	1.3E+01	n							
				5.0E-03	I					0.04			Silver	7440-22-4	3.9E+02	n	5.8E+03	n					9.4E+01	n		8.0E-01	n		
1.2E-01	H			5.0E-03	I					1	0.1		Simazine	122-34-9	4.5E+00	c*	1.9E+01	c					6.1E-01	c	4.0E+00	3.0E-04	c	2.0E-03	
				1.3E-02	I					1	0.1		Sodium Acifluorfen	62476-59-9	8.2E+02	n	1.1E+04	n					2.6E+02	n		2.1E+00	n		
				4.0E-03	I					1			Sodium Azide	26628-22-8	3.1E+02	n	4.7E+03	n					8.0E+01	n			n		
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Sodium Dichromate	10588-01-9	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c		
2.7E-01	H			3.0E-02	I					1	0.1		Sodium Diethyldithiocarbamate	148-18-5	2.0E+00	c	8.5E+00	c					2.9E-01	c		1.8E-04	c		
				5.0E-02	A	1.3E-02	C			1			Sodium Fluoride	7681-49-4	3.9E+03	n	5.8E+04	n	1.4E+01	n	5.7E+01	n	1.0E+03	n			n		
				2.0E-05	I					1	0.1		Sodium Fluoroacetate	62-74-8	1.3E+00	n	1.6E+01	n					4.0E-01	n		8.1E-05	n		
				1.0E-03	H					1			Sodium Metavanadate	13718-26-8	7.8E+01	n	1.2E+03	n					2.0E+01	n			n		
				8.0E-04	P					1			Sodium Tungstate	13472-45-2	6.3E+01	n	9.3E+02	n					1.6E+01	n			n		
				8.0E-04	P					1			Sodium Tungstate Dihydrate	10213-10-2	6.3E+01	n	9.3E+02	n					1.6E+01	n			n		
2.4E-02	H			3.0E-02	I					1	0.1		Stirofos (Tetrachlorovinphos)	961-11-5	2.3E+01	c*	9.6E+01	c					2.8E+00	c		8.2E-03	c		
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Strontium Chromate	7789-06-2	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c		
				6.0E-01	I					1			Strontium, Stable	7440-24-6	4.7E+04	n	7.0E+05	nm					1.2E+04	n		4.2E+02	n		
				3.0E-04	I					1	0.1		Strychnine	57-24-9	1.9E+01	n	2.5E+02	n					5.9E+00	n		6.5E-02	n		
				2.0E-01	I	1.0E+00	I	V		1		8.7E+02	Styrene	100-42-5	6.0E+03	ns	3.5E+04	ns	1.0E+03	n	4.4E+03	n	1.2E+03	n	1.0E+02	1.3E+00	n	1.1E-01	
				3.0E-03	P					1	0.1		Styrene-Acrylonitrile (SAN) Trimer		1.9E+02	n	2.5E+03	n					4.8E+01	n			n		
				1.0E-03	P	2.0E-03	X			1	0.1		Sulfolane	126-33-0	6.3E+01	n	8.2E+02	n	2.1E+00	n	8.8E+00	n	2.0E+01	n		4.4E-03	n		
				8.0E-04	P					1	0.1		Sulfonylbis(4-chlorobenzene), 1,1'-	80-07-9	5.1E+01	n	6.6E+02	n					1.1E+01	n		6.5E-02	n		
						1.0E-03	C	V		1			Sulfur Trioxide	7446-11-9	1.4E+06	nm	6.0E+06	nm	1.0E+00	n	4.4E+00	n	2.1E+00	n			n		
						1.0E-03	C			1			Sulfuric Acid	7664-93-9	1.4E+06	nm	6.0E+06	nm	1.0E+00	n	4.4E+00	n							
2.5E-02	I	7.1E-06	I	5.0E-02	H					1	0.1		Sulfurous acid, 2-chloroethyl 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester	140-57-8	2.2E+01	c	9.2E+01	c	4.0E-01	c	1.7E+00	c	1.3E+00	c		1.5E-02	c		
				3.0E-02	H					1	0.1		TCMTB	21564-17-0	1.9E+03	n	2.5E+04	n					4.8E+02	n		3.3E+00	n		
				7.0E-02	I					1	0.1		Tebuthiuron	34014-18-1	4.4E+03	n	5.7E+04	n					1.4E+03	n		3.0E-01	n		
				2.0E-02	H					1	0.1		Temephos	3383-96-8	1.3E+03	n	1.6E+04	n					4.0E+02	n		7.6E+01	n		
				1.3E-02	I					1	0.1		Terbacil	5902-51-2	8.2E+02	n	1.1E+04	n					2.5E+02	n		7.5E-02	n		
				2.5E-05	H			V		1		3.1E+01	Terbufos	13071-79-9	2.0E+00	n	2.9E+01	n					2.4E-01	n		5.2E-04	n		
				1.0E-03	I					1	0.1		Terbutryn	886-50-0	6.3E+01	n	8.2E+02	n					1.3E+01	n		1.9E-02	n		
				1.0E-04	I					1	0.1		Tetrabromodiphenyl ether, 2,2',4,4'- (BDE-47)	5436-43-1	6.3E+00	n	8.2E+01	n					2.0E+00	n		5.5E-02	n		
				3.0E-04	I			V		1			Tetrachlorobenzene, 1,2,4,5-	95-94-3	2.3E+01	n	3.5E+02	n					1.7E+00	n		7.9E-03	n		
2.6E-02	I	7.4E-06	I	3.0E-02	I			V		1		6.8E+02	Tetrachloroethane, 1,1,1,2-	630-20-6	2.0E+00	c	8.8E+00	c	3.8E-01	c	1.7E+00	c	5.7E-01	c		2.2E-04	c		
2.0E-01	I	5.8E-05	C	2.0E-02	I			V		1		1.9E+03	Tetrachloroethane, 1,1,2,2-	79-34-5	6.0E-01	c	2.7E+00	c	4.8E-02	c	2.1E-01	c	7.6E-02	c		3.0E-05	c		
2.1E-03	I	2.6E-07	I	6.0E-03	I	4.0E-02	I	V		1		1.7E+02	Tetrachloroethylene	127-18-4	2.4E+01	c**	1.0E+02	c**	1.1E+01	c**	4.7E+01	c**	1.1E+01	c**	5.0E+00	5.1E-03	c**	2.3E-03	
				3.0E-02	I					1	0.1		Tetrachlorophenol, 2,3,4,6-	58-90-2	1.9E+03	n	2.5E+04	n					2.4E+02	n		1.8E-01	n		
2.0E+01	H							V		1			Tetrachlorotoxene, p-alpha,alpha,alpha-	5216-25-1	3.5E-02	c	1.6E-01	c					1.3E-03	c		4.5E-06	c		
				5.0E-04	I					1	0.1		Tetraethyl Dithiopyrophosphate	3689-24-5	3.2E+01	n	4.1E+02	n					7.1E+00	n		5.2E-03	n		
						8.0E+01	I	V		1		2.1E+03	Tetrafluoroethane, 1,1,1,2-	811-97-2	1.0E+05	nms	4.3E+05	nms	8.3E+04	n	3.5E+05	n	1.7E+05	n		9.3E+01	n		
				2.0E-03	P					1	0.0007		Tetryl (Trinitrophenylmethylnitramine)	479-45-8	1.6E+02	n	2.3E+03	n					3.9E+01	n		3.7E-01	n		
				2.0E-05	S					1			Thallic Oxide	1314-32-5	1.6E+00	n	2.3E+01	n					4.0E-01	n			n		
				1.0E-05	X					1			Thallium (I) Nitrate	10102-45-1	7.8E-01	n	1.2E+01	n					2.0E-01	n			n		
				1.0E-05	X					1			Thallium (Soluble Salts)	7440-28-0	7.8E-01	n	1.2E+01	n					2.0E-01	n	2.0E+00	1.4E-02	n	1.4E-01	
				1.0E-05	X			V		1			Thallium Acetate	563-68-8	7.8E-01	n	1.2E+01	n					2.0E-01	n		4.1E-05	n		
				2.0E-05	X			V		1			Thallium Carbonate	6533-73-9	1.6E+00	n	2.3E+01	n					4.0E-01	n		8.3E-05	n		
				1.0E-05	X					1			Thallium Chloride	7791-12-0	7.8E-01	n	1.2E+01	n					2.0E-01	n			n		
				1.0E-05	S					1			Thallium Selenite	12039-52-0	7.8E-01	n	1.2E+01	n					2.0E-01	n			n		
				2.0E-05	X					1			Thallium Sulfate	7446-18-6	1.6E+00	n	2.3E+01	n					4.0E-01	n			n		
				4.3E-02	O					1	0.1		Thifensulfuron-methyl	79277-27-3	2.7E+03	n	3.5E+04	n					8.6E+02	n		2.6E-01	n		
				1.0E-02	I					1	0.1		Thiobencarb	28249-77-6	6.3E+02	n	8.2E+03	n					1.6E+02	n		5.5E-01	n		
				7.0E-02	X					1	0.0075		Thiodiglycol	111-48-8	5.4E+03	n	7.9E+04	n					1.4E+03	n		2.8E-01	n		
				3.0E-04	H					1	0.1		Thiofanox	39196-18-4	1.9E+01	n	2.5E+02	n					5.3E+00	n		1.8E-03	n		
1.2E-02	O			2.7E-02	O					1	0.1		Thiophanate, Methyl	23564-05-8	4.7E+01	c*	2.0E+02	c					6.7E+00	c*		5.7E-03	c*		
				1.5E-02	O					1	0.1		Thiram	137-26-8	9.5E+02	n	1.2E+04	n					2.9E+02	n		4.2E-01	n		
				6.0E-01	H					1			Tin	7440-31-5	4.7E+04	n	7.0E+05	nm					1.2E+04	n		3.0E+03	n		
						1.0E-04	A	V		1			Titanium Tetrachloride	7550-45-0	1.4E+05	nm	6.0E+05	nm	1.0E-01	n	4.4E-01	n	2.1E-01	n			n		
				8.0E-02	I	5.0E+00	I	V		1		8.2E+02	Toluene	108-88-3	4.9E+03	ns	4.7E+04	ns	5.2E+03	n	2.2E+04	n	1.1E+03	n	1.0E+03	7.6E-01	n	6.9E-01	
		1.1E-05	C			8.0E-06	C	V		1			Toluene-2,4-diisocyanate	584-84-9	6.4E+00	n	2.7E+01	n	8.3E-03	n	3.5E-02	n	1.7E-02	n		2.5E-04	n		
1.8E-01	X			2.0E-04	X					1	0.1		Toluene-2,5-diamine	95-70-5	3.0E+00	c**	1.3E+01	c*					4.3E-01	c**		1.3E-04	c**		
		1.1E-05	C			8.0E-06	C	V		1		1.7E+03	Toluene-2,6-diisocyanate	91-08-7	5.3E+00	n	2.2E+01	n	8.3E-03	n	3.5E-02	n	1.7E-02	n		2.6E-04	n		
1.6E-02	P	5.1E-05	C							1	0.1		Toluidine, o- (Methylaniline, 2-)	95-53-4	3.4E+01	c	1.4E+02	c	5.5E-02	c	2.4E-01	c	4.7E+00	c		2.0E-03	c		
3.0E-02	P			4.0E-03	X					1	0.1		Toluidine, p-	106-49-0	1.8E+01	c*	7.7E+01	c*					2.5E+00	c*		1.1E-03	c*		
				3.0E+00	P			V		1		3.4E-01	Total Petroleum Hydrocarbons (Aliphatic High)	E1790670	2.3E+05	nms	3.5E+06	nms					6.0E+04	n		2.4E+03	n		
						6.0E-01	P	V		1		1.4E+02	Total Petroleum Hydrocarbons (Aliphatic Low)	E1790666	5.2E+02	ns	2.2E+03	ns	6.3E+02	n	2.6E+03	n	1.3E+03	n		8.8E+00	n		
				1.0E-02	X	1.0E-01	P	V		1		6.9E+00	Total Petroleum Hydrocarbons (Aliphatic Medium)	E1790668	9.6E+01	ns	4.4E+02	ns	1.0E+02	n	4.4E+02	n	1.0E+02	n		1.5E+00	n		
				4.0E-02	P					1	0.1		Total Petroleum Hydrocarbons (Aromatic High)	E1790676	2.5E+03	n	3.3E+04	n					8.0E+02	n		8.9E+01	n		
				4.0E-03	P	3.0E-02	P	V		1		1.8E+03	Total Petroleum Hydrocarbons (Aromatic Low)	E1790672	8.2E+01	n	4.2E+02	n	3.1E+01	n	1.3E+02	n	3.3E+01	n		1.7E-02	n		
				4.0E-03	P	3.0E-03	P	V		1			Total Petroleum Hydrocarbons (Aromatic Medium)	E1790674	1.1E+02	n	6.0E+02	n	3.1E+00	n	1.3E+01	n	5.5E+00	n		2.3E-02	n		
1.1E+00	I	3.2E-04	I							1	0.1		Toxaphene	8001-35-2	4.9E-01	c	2.1E+00	c	8.8E-03	c	3.8E-02	c	7.1E-02	c	3.0E+00	1.1E-02	c	4.6E-01	
				7.5E-03	I					1	0.1		Tralomethrin	66841-25-6	4.7E+02	n	6.2E+03	n					1.5E+02	n		5.6E+01	n		
				3.0E-04	A			V		1			Tri-n-butyltin	688-73-3	2.3E+01	n	3.5E+02	n					3.7E+00	n		8.2E-02	n		
				8.0E+01	X					1	0.1		Triacetin	102-76-1	5.1E+06	nm	6.6E+07	nm					1.6E+06	n		4.6E+02	n		
				3.4E-02	O					1	0.1		Triadimefon	43121-43-3	2.1E+03	n	2.8E+04	n					6.3E+02	n		5.0E-01	n		
7.2E-02	O			2.5E-02	O			V		1			Triallate	2303-17-5	9.7E+00	c	4.6E+01	c					4.7E-01	c		1.0E-03	c		
				1.0E-02	I					1	0.1		Triasulfuron	82097-50-5	6.3E+02	n	8.2E+03	n					2.0E+02	n		2.1E-01	n		
				8.0E-03	I					1	0.1		Tribenuron-methyl	101200-48-0	5.1E+02	n	6.6E+03	n					1.6E+02	n		8.1E-02	n		

TR=1E-06
HQ=1.0

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PRRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; 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)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				5.0E-03	I			V		1			Tribromobenzene, 1,2,4-	615-54-3	3.9E+02	n	5.8E+03	n					4.5E+01	n		6.4E-02	n	
				9.0E-03	X					1	0.1		Tribromophenol, 2,4,6-	118-79-6	5.7E+02	n	7.4E+03	n					1.2E+02	n		2.2E-01	n	
9.0E-03	P			1.0E-02	P					1	0.1		Tributyl Phosphate	126-73-8	6.0E+01	c*	2.6E+02	c*					5.2E+00	c*		2.5E-02	c*	
				3.0E-04	P					1	0.1		Tributyltin Compounds	E1790678	1.9E+01	n	2.5E+02	n					6.0E+00	n			n	
				3.0E-04	I					1	0.1		Tributyltin Oxide	56-35-9	1.9E+01	n	2.5E+02	n					5.7E+00	n		2.9E+02	n	
				3.0E+01	I	5.0E+00	P	V		1		9.1E+02	Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	6.7E+03	ns	2.8E+04	ns	5.2E+03	n	2.2E+04	n	1.0E+04	n		2.6E+01	n	
7.0E-02	I			2.0E-02	I					1	0.1		Trichloroacetic Acid	76-03-9	7.8E+00	c	3.3E+01	c					1.1E+00	c	6.0E+01	2.2E-04	c	1.2E-02
2.9E-02	H									1	0.1		Trichloroaniline HCl, 2,4,6-	33663-50-2	1.9E+01	c	7.9E+01	c					2.7E+00	c		7.4E-03	c	
7.0E-03	X			3.0E-05	X					1	0.1		Trichloroaniline, 2,4,6-	634-93-5	1.9E+00	n	2.5E+01	n					4.0E-01	n		3.6E-03	n	
				8.0E-04	X			V		1			Trichlorobenzene, 1,2,3-	87-61-6	6.3E+01	n	9.3E+02	n					7.0E+00	n		2.1E-02	n	
2.9E-02	P			1.0E-02	I	2.0E-03	P	V		1		4.0E+02	Trichlorobenzene, 1,2,4-	120-82-1	2.4E+01	c**	1.1E+02	c**	2.1E+00	n	8.8E+00	n	1.2E+00	c**	7.0E+01	3.4E-03	c*	2.0E-01
				2.0E+00	I	5.0E+00	I	V		1		6.4E+02	Trichloroethane, 1,1,1-	71-55-6	8.1E+03	ns	3.6E+04	ns	5.2E+03	n	2.2E+04	n	8.0E+03	n	2.0E+02	2.8E+00	n	7.0E-02
5.7E-02	I	1.6E-05	I	4.0E-03	I	2.0E-04	X	V		1		2.2E+03	Trichloroethane, 1,1,2-	79-00-5	1.1E+00	c**	5.0E+00	c**	1.8E-01	c**	7.7E-01	c**	2.8E-01	c**	5.0E+00	8.9E-05	c**	1.6E-03
4.6E-02	I	4.1E-06	I	5.0E-04	I	2.0E-03	I	V	M	1		6.9E+02	Trichloroethylene	79-01-6	9.4E-01	c**	6.0E+00	c**	4.8E-01	c**	3.0E+00	c**	4.9E-01	c**	5.0E+00	1.8E-04	c**	1.8E-03
				3.0E-01	I			V		1		1.2E+03	Trichlorofluoromethane	75-69-4	2.3E+04	ns	3.5E+05	nms					5.2E+03	n		3.3E+00	n	
				1.0E-01	I					1	0.1		Trichlorophenol, 2,4,5-	95-95-4	6.3E+03	n	8.2E+04	n					1.2E+03	n		4.0E+00	n	
1.1E-02	I	3.1E-06	I	1.0E-03	P					1	0.1		Trichlorophenol, 2,4,6-	88-06-2	4.9E+01	c**	2.1E+02	c**	9.1E-01	c	4.0E+00	c	4.1E+00	c**		4.0E-03	c*	
				1.0E-02	I					1	0.1		Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	6.3E+02	n	8.2E+03	n					1.6E+02	n		6.8E-02	n	
				8.0E-03	I					1	0.1		Trichlorophenoxypropionic acid, -2,4,5	93-72-1	5.1E+02	n	6.6E+03	n					1.1E+02	n	5.0E+01	6.1E-03	n	2.8E-02
				5.0E-03	I			V		1		1.3E+03	Trichloropropane, 1,1,2-	598-77-6	3.9E+02	n	5.8E+03	ns					8.8E+01	n		3.5E-02	n	
3.0E+01	I			4.0E-03	I	3.0E-04	I	V	M	1		1.4E+03	Trichloropropane, 1,2,3-	96-18-4	5.1E-03	c	1.1E-01	c	3.1E-01	n	1.3E+00	n	7.5E-04	c		3.2E-07	c	
				3.0E-03	X	3.0E-04	P	V		1		3.1E+02	Trichloropropene, 1,2,3-	96-19-5	7.3E-01	n	3.1E+00	n	3.1E-01	n	1.3E+00	n	6.2E-01	n		2.1E-04	n	
				2.0E-02	A					1	0.1		Tricresyl Phosphate (TCP)	1330-78-5	1.3E+03	n	1.6E+04	n					1.6E+02	n		1.5E+01	n	
				3.0E-03	I					1	0.1		Tridiphane	58138-08-2	1.9E+02	n	2.5E+03	n					1.8E+01	n		1.3E-01	n	
						7.0E-03	I	V		1		2.8E+04	Triethylamine	121-44-8	1.2E+02	n	4.8E+02	n	7.3E+00	n	3.1E+01	n	1.5E+01	n		4.4E-03	n	
				2.0E+00	P					1	0.1		Triethylene Glycol	112-27-6	1.3E+05	nm	1.6E+06	nm					4.0E+04	n		8.8E+00	n	
						2.0E+01	P	V		1		4.8E+03	Trifluoroethane, 1,1,1-	420-46-2	1.5E+04	ns	6.2E+04	ns	2.1E+04	n	8.8E+04	n	4.2E+04	n		1.3E+03	n	
7.7E-03	I			7.5E-03	I			V		1			Trifluralin	1582-09-8	9.0E+01	c**	4.2E+02	c*					2.6E+00	c*		8.4E-02	c*	
2.0E-02	P			1.0E-02	P					1	0.1		Trimethyl Phosphate	512-56-1	2.7E+01	c*	1.1E+02	c*					3.9E+00	c*		8.6E-04	c*	
				1.0E-02	I	6.0E-02	I	V		1		2.9E+02	Trimethylbenzene, 1,2,3-	526-73-8	3.4E+02	ns	2.0E+03	ns	6.3E+01	n	2.6E+02	n	5.5E+01	n		8.1E-02	n	
				1.0E-02	I	6.0E-02	I	V		1		2.2E+02	Trimethylbenzene, 1,2,4-	95-63-6	3.0E+02	ns	1.8E+03	ns	6.3E+01	n	2.6E+02	n	5.6E+01	n		8.1E-02	n	
				1.0E-02	I	6.0E-02	I	V		1		1.8E+02	Trimethylbenzene, 1,3,5-	108-67-8	2.7E+02	ns	1.5E+03	ns	6.3E+01	n	2.6E+02	n	6.0E+01	n		8.7E-02	n	
				1.0E-02	X			V		1		3.0E+01	Trimethylpentane, 2,4,4-	25167-70-8	7.8E+02	ns	1.2E+04	ns					6.5E+01	n		2.2E-01	n	
				3.0E-02	I					1	0.019		Trinitrobenzene, 1,3,5-	99-35-4	2.2E+03	n	3.2E+04	n					5.9E+02	n		2.1E+00	n	
3.0E-02	I			5.0E-04	I					1	0.032		Trinitrotoluene, 2,4,6-	118-96-7	2.1E+01	c**	9.6E+01	c**					2.5E+00	c**		1.5E-02	c**	
				2.0E-02	P					1	0.1		Triphenylphosphine Oxide	791-28-6	1.3E+03	n	1.6E+04	n					3.6E+02	n		1.5E+00	n	
				2.0E-02	A					1	0.1		Tris(1,3-Dichloro-2-propyl) Phosphate	13674-87-8	1.3E+03	n	1.6E+04	n					3.6E+02	n		8.0E+00	n	
				1.0E-02	X					1	0.1		Tris(1-chloro-2-propyl)phosphate	13674-84-5	6.3E+02	n	8.2E+03	n					1.9E+02	n		6.5E-01	n	
2.3E+00	C	6.6E-04	C					V		1		4.7E+02	Tris(2,3-dibromopropyl)phosphate	126-72-7	2.8E-01	c	1.3E+00	c	4.3E-03	c	1.9E-02	c	6.8E-03	c		1.3E-04	c	
2.0E-02	P			7.0E-03	P					1	0.1		Tris(2-chloroethyl)phosphate	115-96-8	2.7E+01	c*	1.1E+02	c*					3.8E+00	c*		3.8E-03	c*	
3.2E-03	P			1.0E-01	P					1	0.1		Tris(2-ethylhexyl)phosphate	78-42-2	1.7E+02	c*	7.2E+02	c					2.4E+01	c*		1.2E+02	c*	
				8.0E-04	P					1			Tungsten	7440-33-7	6.3E+01	n	9.3E+02	n					1.6E+01	n		2.4E+00	n	
				2.0E-04	A	4.0E-05	A			1			Uranium (Soluble Salts)	E715565	1.6E+01	n	2.3E+02	n	4.2E-02	n	1.8E-01	n	4.0E+00	n	3.0E+01	1.8E+00	n	1.4E+01
1.0E+00	C	2.9E-04	C						M	1	0.1		Urethane	51-79-6	1.2E-01	c	2.3E+00	c	3.5E-03	c	4.2E-02	c	2.5E-02	c		5.6E-06	c	
		8.3E-03	P	9.0E-03	I	7.0E-06	P			0.026			Vanadium Pentoxide	1314-62-1	4.6E+02	c**	2.0E+03	c**	3.4E-04	c*	1.5E-03	c*	1.5E+02	n			n	
				5.0E-03	S	1.0E-04	A			0.026			Vanadium and Compounds	7440-62-2	3.9E+02	n	5.8E+03	n	1.0E-01	n	4.4E-01	n	8.6E+01	n		8.6E+01	n	
				1.0E-03	I			V		1			Vernolate	1929-77-7	7.8E+01	n	1.2E+03	n					1.1E+01	n		8.9E-03	n	
				1.2E-03	O					1	0.1		Vinclozolin	50471-44-8	7.6E+01	n	9.8E+02	n					2.1E+01	n		1.6E-02	n	
				1.0E+00	H	2.0E-01	I	V		1		2.8E+03	Vinyl Acetate	108-05-4	9.1E+02	n	3.8E+03	ns	2.1E+02	n	8.8E+02	n	4.1E+02	n		8.7E-02	n	
		3.2E-05	H			3.0E-03	I	V		1		2.5E+03	Vinyl Bromide	593-60-2	1.2E-01	c*	5.2E-01	c*	8.8E-02	c*	3.8E-01	c*	1.8E-01	c*		5.1E-05	c*	
7.2E-01	I	4.4E-06	I	3.0E-03	I	1.0E-01	I	V	M	1		3.9E+03	Vinyl Chloride	75-01-4	5.9E-02	c	1.7E+00	c	1.7E-01	c	2.8E+00	c	1.9E-02	c	2.0E+00	6.5E-06	c	6.9E-04
				3.0E-04	I					1	0.1		Warfarin	81-81-2	1.9E+01	n	2.5E+02	n					5.6E+00	n		5.9E-03	n	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, P-	106-42-3	5.6E+02	ns	2.4E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.9E-01	n	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, m-	108-38-3	5.5E+02	ns	2.4E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.9E-01	n	
				2.0E-01	S	1.0E-01	S	V		1		4.3E+02	Xylene, o-	95-47-6	6.5E+02	ns	2.8E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.9E-01	n	
				2.0E-01	I	1.0E-01	I	V		1		2.6E+02	Xylenes	1330-20-7	5.8E+02	ns	2.5E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n	1.0E+04	1.9E-01	n	9.9E+00
				3.0E-04	I					1			Zinc Phosphide	1314-84-7	2.3E+01	n	3.5E+02	n					6.0E+00	n			n	
				3.0E-01	I					1			Zinc and Compounds	7440-66-6	2.3E+04	n	3.5E+05	nm					6.0E+03	n		3.7E+02	n	
				5.0E-02	I					1	0.1		Zineb	12122-67-7	3.2E+03	n	4.1E+04	n					9.9E+02	n		2.9E+00	n	
				8.0E-05	X					1			Zirconium	7440-67-7	6.3E+00	n	9.3E+01	n					1.6E+00	n		4.8E+00	n	

TR=1E-06
HQ=1.0

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Appendix D Sites of Concern

CDOT Parcel #	Address	Denver Parcel Number
PE-197	5151 Franklin Street	0214300148000
AP-86, AP-86A, AP-86B	3223 E. 46th Ave., 3495 E. 46th Ave., and 3455 E. 46th Ave.	0224100029000, 0224100031000
AP-91, AP-93, AP-93A	4501 Monroe St., 3538 E. 46th Ave., and 3600 E. 46th Ave.	0224105015000, 0224105014000, 0224104011000
AP-96	4605 Jackson St.	0224100032000
AP-94	3601 E. 46th Ave.	0224100033000
AP-88	3501 E. 46th Ave.	0224100028000
AP-55	4600 Josephine St.	0224213015000
AP-52	4631 Josephine St.	0224212018000
IU	4375 Havana St.	0122400004000

Railroad Parcel #	Denver Parcel Number
UPRR	
Construction License Permit 26	0223124001000, 0223400057000, 0223123004000, 0223123003000, 0223123011000, 0223122002000, 0223100046000, additional area w/o schedule #
BNSF	
TE-90; TE-90A	0224121009000, 0224100006000
PE-90; PE-90A	0224121009000, 02241000, 6000
DRIR	
RW-136; RW-136B	0120100045000, 0120100063000
PE-136A	no schedule # assigned

Appendix E CDPHE GIS Mapping Requirements for Environmental Covenants

Revised 03/19/2012

Non-Technical information for administrative use:

Colorado Department of Public Health and Environment (CDPHE) requires a computerized delineation of the actual part of the property (Institutional Control Boundary) that is to be covered by the Environmental Covenant. This data will be used to create something similar to what one might find on the commercial Map Quest or Google Map sites. A new survey is rarely needed to create this covenant outline. A mapping professional such as geographic information systems (GIS) technician or geographer will be your best resource for completing this requirement. Sometimes a larger surveying company may also be capable of delivering this data. Technical information below will be required by mapping professional. Legal descriptions alone or printed maps will not be accepted. CDPHE requires an electronic form of the geographic data described in the Technical users information below. If you have questions, please contact Paul Will, GIS Manager, Paul.Will@state.co.us

Technical information for GIS application:

CDPHE uses Environmental Systems Research Institute, Inc. (ESRI) software to create polygons representing the actual geometry of the Institutional Control Boundary for Environmental Covenant requested. We require spatially referenced electronic formats, which can be imported into ESRI ArcGIS databases.

1. GIS data must have least 3 meter accuracy, tied to a known (unmodified) world projection system.
2. ESRI "shape" files are preferred.
3. CAD files are only accepted when the files are electronically geospatially enabled. ONLY include the relevant outline and/or vector points. Do not send an entire CAD projects which include annotations and other features.
4. Non proprietary data submissions are allowed. Sequential point (X, Y or Latitude, Longitude) data are acceptable in a delimited .txt format. Projection datum used must be included.
5. The projection must be standard and identified including
   - Projection system, Datum, Zone and Units
6. The preferred projection is UTM, NAD83, meters, and Zone 13N.
   - UTM
     NAD_1983_UTM_Zone_13N
     GCS_North_American_1983
     Angular Unit: Degree (0.017453292519943295)
     Prime Meridian: Greenwich (0.000000000000000000)
     Datum: D_North_American_1983
     Spheroid: GRS_1980
     Semimajor Axis: 6378137.000000000000000000
     Semiminor Axis: 6356752.314140356100000000
     Inverse Flattening: 298.257222101000020000
     (Zone 13 N is required for the entire state even though a small western part of the state does fall into Zone 12 N).
     Units = Meters
     Please check your projection, errors may cause substantial delays.

In most cases, when new measurements are needed, data collected with accuracy of hand held GPS units should work. This is intended to be a graphic representation; it will not be used as a legal reference. The legal description is taken care of elsewhere in the Environmental Covenant. Legal descriptions alone will not be accepted for this application, it must be spatially enabled data in an electronic format.

Attachment 4: Sampling and Analysis Plan

Kiewit meridiam PARTNERS

Sampling and Analysis Plan – Operable Unit 2

SUBMITTED TO:
Colorado Bridge Enterprise
High Performance Transportation Enterprise
c/o Colorado Department of Transportation

RECORD OF REVISIONS

Revision number	Date issued	Pages affected	Comments
0	08/20/2018	All	Initial Submission
1	08/24/2018	1, 5	IQC Revisions
2	04/29/2019	All	CDOT & CCD Comments Addressed
3	05/22/2019	2-7, 15	Addressed CCD Comments

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DELIVERABLE CERTIFICATION

As per Schedule 8, Section 6.7.3 Document and Data Approval, I Megan Wood as the originator of this deliverable certify this deliverable to be complete and meets the requirements of the Project Agreement.

Megan Wood	_____	05/22/2019
Printed Name of Originator	Signature of Originator	Date

TABLE OF CONTENTS

1. Introduction 1
1.1 Location and Description of Project 1
2. Project Organization 1
3. Data Quality Objectives 2
3.1 Measurement Performance Criteria 3
4. Field Methods and Sampling Procedures 3
4.1 Soil Sampling 3
4.1.1 Soil Sampling Methodology 4
4.1.2 Field Screening Observations 5
4.1.3 Soil Collection Procedures 5
4.2 Groundwater sampling 6
4.3 Import Fill Material Sampling 6
4.4 Investigation-Derived Waste 6
4.5 Decontamination 7
4.5.1 Equipment 7
4.5.2 Personal Protective Equipment 7
5. Laboratory Analysis 7
5.1 Soil Sample Analysis 8
5.2 Dewatering Groundwater Analysis 8
5.3 Imported Fill Sample Analysis 8
6. Quality Assurance Objectives and Quality Control Objectives (Data) 9
6.1 Sample Handling Procedure 9
6.1.1 Sample containers and preservation 9
6.1.2 Sample designation 10
6.1.3 Sample custody 11
6.1.4 Sample preservation and packaging 12
6.1.5 Equipment calibration 12
6.2 Field and Laboratory Quality Control 12
6.3 Laboratory Quality Control Samples 13
7. Reporting 13
8. Provisions for Corrective Action 14

ED_002842A_00000589-00178

APPENDICIES

Appendix A	OU2 Area Map & Drawings
Appendix B	Target Analyte Comparison Criteria
Appendix C	Low Flow Groundwater Sampling Procedure

ACRONYMS

ACM	Asbestos Containing Material
BRMMP	Beneficial Reuse Materials Management Plan
CCD	City and County of Denver
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CLP	Contract Laboratory Program
CM	Compliance Manager
DADS	Denver Arapahoe Disposal Site
DPT	Direct Push Technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
EB	Equipment Blank
GPS	Global Positioning System
GPV	Groundwater Protection Value
HASP	Health and Safety Plan
IDW	Investigation-Derived Waste
KMP	Kiewit Meridian Partners
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MDL	Method Detection Limit
MMP	Materials Management Plan
MSD	Matrix Spike Duplicate
MS	Matrix Spike

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MT	Monitoring Technician
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbons
PAL	Pre-Determined Action Levels
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PLM	Polarized Light Microscopy
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
RACS	Regulated Asbestos Containing Soil
RCRA	Resource Conservation and Recovery Act
RHM	Recognized Hazardous Materials
RSL	Regional Screening Level
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TB	Trip Blank
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
USEPA	US Environmental Protection Agency
VOC	Volatile Organic Compound

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1. Introduction

Kiewit Meridian Partners (KMP) has prepared this Sampling and Analysis Plan (SAP) to provide Data Quality Objectives (DQO), field sampling methods, field equipment calibration procedures, laboratory analytical methods, quality assurance/quality control (QA/QC) procedures, and procedures for corrective actions (if needed) for use when identifying and classifying Recognized Hazardous Materials (RHMs) during excavation and import of fill during construction of the Central 70 Project (the Project) as it pertains to U.S. Environmental Protection Agency's (USEPA's) Operable Unit 2 (OU2) of the Vasquez Boulevard and I-70 Superfund Site. This plan complies with the Colorado Department of Transportation's (CDOT's) Beneficial Reuse and Materials Management Plan (BRMMP) dated September 12, 2017 and federal and state regulations.

This SAP is specific to construction activities as they relate to OU2 and is used in conjunction with the OU2 Materials Management Plan (MMP), and the Central 70 Project Health and Safety Plan (HASP). The goal of the activities covered within this SAP are to provide proper procedures for sampling and analysis, in order to accurately characterize and classify RHMs in accordance with the OU2 MMP and to accurately test imported fill for acceptance.

1.1 LOCATION AND DESCRIPTION OF PROJECT

The Project is located along the I-70 corridor between I-25 and Chambers Road in Denver and Adams Counties, in Colorado. The Project is surrounded by residential, commercial, and industrial areas. The Project consists of reconstructing a 10-mile segment of I-70 east of downtown Denver; reconstructing I-70 from Brighton Boulevard to I-270, including adding one express lane in each direction, removing the 53-year old viaduct, and lowering the interstate between Brighton Boulevard and Colorado Boulevard; constructing a 4-acre cover park over a portion of the lowered interstate; and widening I-70 from I-270 to Chambers Road to add one express lane in each direction.

OU2 is a defined area within the Vasquez Boulevard and I-70 Superfund site (VB/I-70) located in northeast Denver near the Project corridor (Appendix A). Historically, the area was a major smelting center with two smelting plants refining gold, silver, copper, lead, and zinc. As a result, heavy metals were deposited in area soils at levels that posed a health risk for people living there. Groundwater was also impacted at these former smelter locations. In addition, the Denver Coliseum parking lot, within OU2 boundaries, is the site of the 1950s-era Denver municipal landfill where known asbestos containing materials (ACM) have been identified.

Construction operations to occur within OU2 boundaries include installation of approximately 400 lineal feet (lf) of sanitary sewer to be tied into the existing Delgany Interceptor. Work activities include excavation and removals, installation of the new sanitary sewer with associated tie-in, and restoration of the work area.

2. Project Organization

KMP is the primary contractor responsible for the satisfactory implementation of the sampling and analysis of the OU2 work area and any potential RHMs. In this capacity, KMP will oversee and monitor the work.

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KMP will be utilizing a licensed and trained subcontractor to complete the sanitary sewer line work within OU2. KMP also provides licensed and appropriately trained field personnel, including a Compliance Manager (CM)/RHM Manager and Monitoring Technician (MT), to oversee sampling and analysis of potential RHMs related to the OU2 construction activities (Table 1).

The following table identifies key technical project personnel responsible for implementation of this plan.

Table 1: Key Project Personnel Contact Information and Responsibilities

Responsibility	Name	Organization	Phone Number	Email
CDOT Environmental Project Manager	Tim Buntrock	CDOT	(303) 404-7043	Timonth.buntrock@state.co.us
CDOT Recognized Hazardous Materials Manager	Scott Epstein	Pinyon Environmental	(303) 594-2862	epstein@pinyon-env.com
KMP Environmental Project Manager	Megan Wood	Kiewit Infrastructure	(970) 819-8147	Megan.Wood1@Kiewit.com
KMP Health and Safety Officer	Ron Crandall	Foothills Environmental	(720) 254-0279	ron@foothillsusa.com
Environmental Soil Sampling Task Manager*	Andrew Umyn	Iron Woman	(303) 947-6453	AUmyn@ironwomancon.com
RHM Manager/ Compliance Manager	Laura Tobin	WSP	(303) 726-8100	Laura.Tobin@wsp.com
Monitoring Technicians*	Andrew Umyn	Iron Woman	(303) 947-6453	AUmyn@ironwomancon.com

*Iron Woman has been subcontracted to complete assigned construction operations (including investigative sampling) within the OU2 work area.

3. Data Quality Objectives

The DQO process establishes performance criteria for data collection activities. These criteria, in turn, serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support goals of the investigation activities. The process is systematic and begins by defining the problem and identifying the goals and objectives of this SAP as well as measurement performance criteria. Data collection methods and the analytical approach are designed to satisfy the goals and objectives of this SAP.

The goals and objectives of conducting the environmental sampling for the OU2 work area are to further classify soil, groundwater, groundwater comingled with stormwater, and those materials identified in the OU2 MMP that will be encountered during construction. The purpose of the sampling is to ensure that material encountered during construction has been adequately sampled for reuse (asphalt, concrete, and road base in accordance with state approved uses as referenced in the MMP) and disposal. Sampling is being conducted in advance of construction per the Colorado Department of Public Health and Environment's (CDPHE) request.

3.1 MEASUREMENT PERFORMANCE CRITERIA

A central aspect of the DQO process is the documentation of the Data Quality Indicators (DQI). DQI's specify the performance criteria and acceptance criteria for the quality of the data collected for the SAP to be included in the final construction and management of materials for the OU2 operations.

"Precision", is a measure of reproducibility of test results. A series of measurements on the same sample for the same parameter is compared to the average value. Precision is estimated by means of duplicate/replicate analyses.

"Accuracy", is the degree of agreement of a measurement with an acceptable reference or true value.

"Comparability", expresses the confidence with which one data set can be compared to another. The use of generally accepted and published methods through this SAP allows the data to be compared to similar data sets, facilitating evaluation, and ensures reporting of data in comparable units.

"Sensitivity", is an absolute quantity, the smallest absolute amount of change that can be detected by a measurement. This will be addressed by laboratory method detection limits (MDLs) for analytes of interest. These detection limits will be compared to the applicable USEPA and CDPHE regulatory criteria that will be used to make a waste determination to ensure the appropriate laboratory MDL is used.

The analytical laboratory selected for this project will be responsible for establishing measurement criteria for precision and accuracy of the analytical procedures used in environmental and geotechnical analysis. Data for these Quality Control procedures are obtained by analyses of duplicate samples and trip blanks, which is described in detail in Section 6.

4. Field Methods and Sampling Procedures

This section describes the field methodology and sampling procedures for soil and groundwater that are followed prior to commencing construction operations, and during the excavation and soil removal phases of the activities in OU2, including field screening and further sampling of soil, groundwater, and import fill material. Field work will be conducted in accordance with this SAP, the Project HASP, the OU2 MMP, KMP's safety protocols, and state and federal requirements. Construction workplans will further detail the environmental sampling and construction activities.

4.1 SOIL SAMPLING

Before conducting the environmental drilling activities and collection of soil samples, KMP will mark the proposed soil boring locations in the field with flagging on stakes, nails with whiskers, or paint on hard surface as appropriate. The proposed bore locations will be photographed to document the initial conditions and a handheld global positioning system (GPS) unit will be used to record the location.

The areas will be inspected for indications of subsurface utilities, overhead obstructions, and traffic control needs. As the investigation locations are marked, the drilling contractor will initiate the utility notification process for the drilling locations. Public and private utility locators will mark the investigation locations before drilling or ground breaking occurs.

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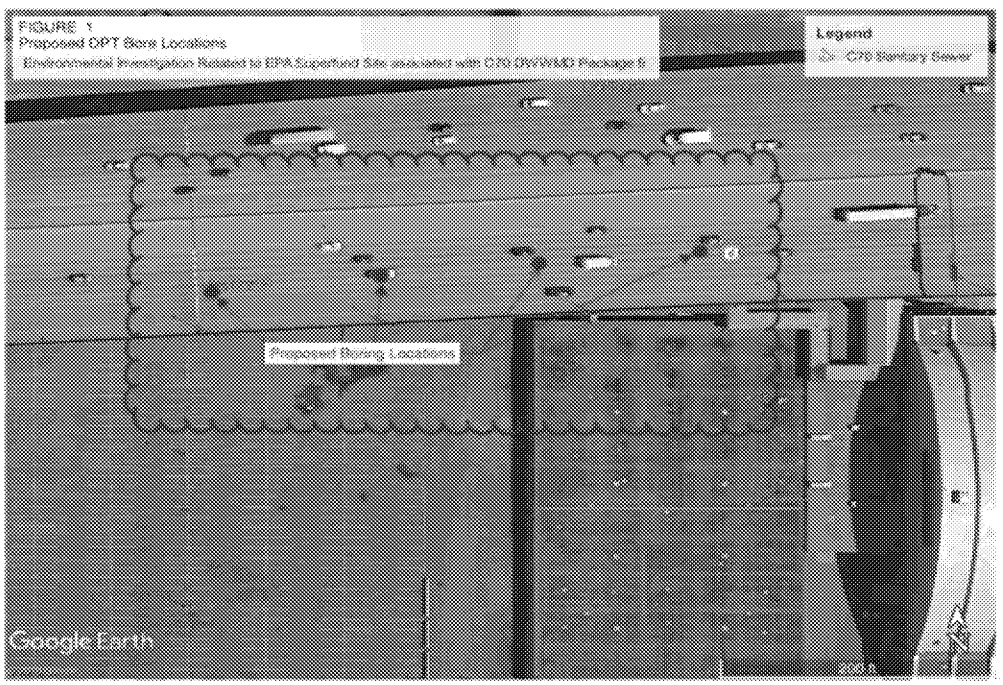
At each bore location, remaining soil after all samples are collected will be containerized and transported for off-site disposal at Denver Arapahoe Disposal Site (DADS). Additional details regarding waste characterization sampling is included in Section 5.

4.1.1 SOIL SAMPLING METHODOLOGY

The construction operations within the OU2 boundary impact a small working area. The sanitary sewer line install that will tie-in to the Delgany Interceptor is approximately 400 lf resulting in roughly 1800 cubic yards (CY) of excavated soil. To sample this volume of soil for future disposal purposes, KMP will advance four bores using direct push technology (DPT) at the pre-surveyed locations along the approximate center-line of the proposed sewer line corridor (Figure 1). Bores will be separated from each other by a distance that is based on the length of excavation (representing approximately 450 CY of material to be removed). At each of the four locations, the DPT-rig will advance sample rod continuously in 4-foot increments in order to collect a representative, and relatively undisturbed, core sample of the subsurface material anticipated to be encountered during installation of the sewer line. Three (3) samples will be collected from the recovered core. Samples will be collected at three intervals within each vertical bore: 1) within the unsaturated/vadose zone in the 1-5-foot interval, 2) at the groundwater interface (if encountered), and 3) at the bottom of the excavation (approximate elevation 5150'), termination point of the bore, or the interval of soil/fill material where the highest head-space reading was observed. Figure 1 below identifies anticipated bore locations spaced along the general alignment of the proposed sewer line.



Sampling for soils containing suspect ACM should be done in accordance with CDOT's Regulated Asbestos Contaminated Soil Management Standard Operating Procedure, found in the OU2 MMP, Appendix F.

4.1.2 FIELD SCREENING OBSERVATIONS

During soil sampling, excavation activities and dewatering as described in the MMP, the Monitoring Technician (MT) will observe the following "looks bad, smells bad" parameters and document observations as well as olfactory findings in a field log. KMP documents each soil sample and excavated location by compiling field notes, taking pictures, surveying the location, and noting field screening observations and results, including:

- Visual staining, including discoloration (i.e. gray material, indicating reducing subsurface conditions), or dark coloration
- Presence of non-soil/fill materials (e.g., debris, sludge, powders, coal-based fill)
    - Paint chips
    - Suspect ACM
    - Coatings or paint on asphalt or concrete
- Evidence of dumping
- Presence of distinguishable odor
- Discrete layers in a soil cross-section that generally appear out of place
- Visual sheen on groundwater
- Photoionization detector (PID) screening results

Soil will be collected and screened using the headspace technique. To complete this screening, soil from the sampler core will be placed in a heavy-duty zipper style plastic bag and sealed. The bag is shaken vigorously for approximately 15 seconds to disaggregate the sample and expose as much surface area of the soil as possible (to release the VOCs to the atmosphere within the bag). If necessary, the sample is warmed to room temperature (70° Fahrenheit, [°F]) by placing the bag in a heated room or vehicle. The VOCs, if present, will volatilize into the sealed bag. Allow the bag to stand (to achieve equilibrium) for approximately 15 minutes. The bag is carefully opened slightly and the tip of the PID is placed into the opening. The tip of the probe should be inserted into the soil material and the uptake of water droplets should be avoided. The PID should be allowed to equilibrate and the highest PID measurement noted will be recorded. Erratic PID responses may result from high organic vapor concentrations or elevated headspace moisture. If these conditions exist, the MT shall qualify the headspace data in the field book. It is also important to record the ambient temperature, humidity, and whether moisture was present in plastic bag. Samples collected for headspace screening cannot be retained for VOC laboratory analysis. Additionally, a discussion of health and safety related monitoring is described in the HASP.

RHMs are defined as the presence or suspected presence of hazardous substances which may require management or disposal. Hazardous substances may exist on the surface, in the subsurface, or in groundwater, and may be mixed with soil, water, and/or other waste materials. The necessary requirements regarding the handling of RHMs are discussed in the MMP.

KMP intends to dispose of all soil and groundwater waste derived during soil and groundwater sampling and construction activities. As detailed in the MMP, samples will be analyzed against the target analyte criteria required by the disposal facility, DADS.

4.1.3 SOIL COLLECTION PROCEDURES

Both grab and composite soil samples will be collected. Grab soil samples are collected using hand tools (e.g. split spoons, trowel, spoons, or shovels) and placed by gloved-hand into 4-ounce, laboratory-supplied

jars, minimizing sample handling and jar headspace. The MT dons a clean pair of new, disposable gloves each time a different sample is collected and immediately prior to sampling. For composite soil samples, the MT identifies the location of the sub-samples and obtains a small aliquot of soil from each sub-sample location. The sub-samples are placed in a Ziploc bag, which is closed between each sub-sample location to minimize volatilization. After each of the sub-samples have been collected and placed in the bag, the soil in the bag is gently mixed and homogenized, and the certified-clean soil sample jars are filled to the brim with the combined soil to reduce the amount of remaining headspace.

Soil sample locations are recorded in the field logbook as sampling is completed. A sketch of the sample location is recorded in the logbook, any physical reference points are labeled, and the distance from any suitable reference point is measured.

Sample containers are immediately labeled and placed in a cooler on ice, pending transport to the laboratory under chain of custody protocol.

4.2 GROUNDWATER SAMPLING

Groundwater encountered in each bore will be sampled for waste characterization according to the procedures described below. The MT will don a clean pair of new, disposable gloves each time a different sample is collected and immediately prior to sampling. A temporary well will be installed to collect a groundwater sample using the low flow sampling method in accordance with USEPA standard operating procedures included as Appendix C.

The groundwater is placed in laboratory-supplied containers that have been pre-preserved. The sample containers are immediately labeled and placed in a cooler on ice pending transport to the laboratory under chain of custody protocol. Any analyses requiring short hold times are identified in advance of any sampling event and transport is arranged to accommodate the required timeframes.

4.3 IMPORT FILL MATERIAL SAMPLING

KMP samples import fill at a minimum frequency of one composited sample for every 500 cubic yards from each source area. Sub-samples are placed in a Ziploc bag, which is closed between each sub-sample location to minimize volatilization. After all of the sub-samples have been collected, the soil in the bag is gently mixed to homogenize, and the sample jars are filled from the combined soil.

Soil sample locations are recorded in the field logbook as sampling is completed. A sketch of the sample location is recorded in the logbook and any physical reference points are labeled.

Sample containers are immediately labeled and placed in a cooler on ice, pending transport to the laboratory under chain of custody protocol.

4.4 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) soil or groundwater is placed into separate location and waste-stream-specific, Department of Transportation (DOT)-compliant containers; labeled; and moved to a designated staging area (within OU2 boundaries), for waste characterization sampling and determination. If the IDW is

presumed to be hazardous, it must be labeled "Hazardous Waste – Pending Analysis." The location and volume of IDW is recorded in the field log.

Waste characterization samples are collected as follows. A clean pair of new, disposable gloves is donned immediately prior to sampling. A composite sample soil sample is collected from each container using hand tools (e.g. split spoons, trowel, spoons, or shovels) and placed by gloved-hand into 4-ounce, laboratory-supplied jars, while minimizing sample handling and headspace. Water samples are collected using a decontaminated glass or stainless-steel cup. One composite sample is collected per container.

Sample containers are immediately labeled and placed in a cooler on ice, pending transport to the laboratory under chain of custody protocol.

4.5 DECONTAMINATION

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. It is critical to health and safety at sites where the potential for exposure to hazardous chemicals is present. Decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment; it protects site personnel by minimizing the transfer of harmful materials into clean areas; it helps prevent mixing of incompatible chemicals; and it protects the community by preventing uncontrolled transportation of contaminants from the Project.

Water used in the wash down or decontamination of personnel and/or equipment is containerized for proper disposal. This water contains used detergent and small quantities of residues removed from equipment components during washing down or decontamination. Under no circumstances is wash water be allowed to leave the Project or otherwise be discharged.

4.5.1 EQUIPMENT

Equipment is decontaminated before it arrives onsite and before demobilizing. In addition, decontamination is conducted between each collected sample. The soil and groundwater sampling mixing containers and hand tools are decontaminated between each sample location using a potable water and non-phosphatic soap wash followed by a distilled water rinse. Equipment that was decontaminated before arriving at the facility is inspected before use to ensure that it did not become compromised during transport.

4.5.2 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) such as disposable nitrile or latex gloves are bagged and disposed of as municipal waste. Personal steel-toed boots, hard hats, safety vests, and safety glasses are wiped down with detergent and water, if there are visible signs of the items being dirty.

5. Laboratory Analysis

This section describes the analytical testing performed on collected samples, including soil, dewatering groundwater, and imported fill material.

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5.1 SOIL SAMPLE ANALYSIS

The following analytical parameters and methods are utilized for soil sampling. The CM/RHM Manager or MT may modify this list for potentially impacted soil based on field screening observations.

- Poly Aromatic Hydrocarbons (PAHs) by EPA Method 8270C/D
- Resource Conservation and Recovery Act (RCRA) 8 metals by EPA Method 6010C/7471B/8011
- Volatile Organic Compounds (VOCs) by EPA Method 8260B/8270C
- Asbestos (PLM) – if warranted by the MT/Certified Asbestos Building Inspector (CABI) who is completing the field screening

If concentrations in soil exceed the groundwater protection value (GPV) indicating that the soil has the potential to impact water quality, individual compounds are further analyzed using Toxicity Characteristic Leachate Procedure (TCLP) methodology. Additionally, TCLP analysis is conducted for analytical parameters that do not have an associated GPV (e.g., metals). If concentrations of any contaminant exceed the 20-Times Rule, then analysis by TCLP for that compound is conducted.

Samples may further be submitted for waste characterization analysis as required by the disposal facility. Target analyte comparison criteria for the disposal facility is included in Appendix B of the SAP.

5.2 DEWATERING GROUNDWATER ANALYSIS

The following parameters and methods are included for dewatering groundwater analysis for disposal characterization. This list will be updated should KMP pursue a dewatering permit and implement associated treatment. The below constituents and methods are consistent with the analysis that will likely be required at a minimum for both treatment and disposal options:

- Total RCRA metals by EPA Method 6010C/6020A/7196A
- VOCs by EPA Method 8260B/8270C.
- SVOCs by EPA Method 8260B/8270C/8270D.
- TSS by EPA Method 2540D.
- TS by EPA Method 1684
- pH by EPA Method 9040C
- TPH by EPA Method 8015
- PCBs by EPA Method 8082

The CM or MT may select additional analytical parameters based on field screening observations, as described in the OU2 MMP and in compliance with any permit requirements. Target analyte comparison criteria for the disposal facility is included in Appendix B of the SAP.

5.3 IMPORTED FILL SAMPLE ANALYSIS

The following parameters and methods are included for import fill analysis.

- VOCs (EPA Method 8260B)
- SVOCs (EPA Method 8270)
- Total petroleum hydrocarbons (TPHs) (EPA Method 8015)
- RCRA 8 metals (EPA Method 6010 and 7471)
- Pesticides (EPA Method 8081)
- PCBs (EPA Method 8082)
- Herbicides (EPA Method 8151A)
- Asbestos (PLM)

6. Quality Assurance Objectives and Quality Control Objectives (Data)

The goal of the Quality Assurance/Quality Control (QA/QC) program is to provide a plan for obtaining the type and quality of data needed to support environmental decision-making. The objective is to integrate all technical and quality aspects of the project and document QA/QC and technical activities and procedures associated with planning, implementing, and assessing environmental data collection. The following sections describe QA/QC procedures employed when collecting, handling, and analyzing environmental samples.

6.1 SAMPLE HANDLING PROCEDURE

To ensure samples are correctly identified and remain representative of the sampled media, the sample documentation and custody procedures outlined in this section will be adhered to during the sampling program to maintain and document sample integrity during collection, transportation, storage, and analysis. The MTs are responsible for ensuring proper documentation and custody procedures are initiated at the time of sample collection, and that individual samples can be tracked from the time of sample collection until custody of the samples is transferred to the laboratory. The laboratory is responsible for maintaining sample custody and documentation from the time the laboratory receives the samples until final sample disposal.

6.1.1 SAMPLE CONTAINERS AND PRESERVATION

Each sample container is obtained from the laboratory specifically for the applicable soil or groundwater analysis. The laboratory is responsible for cleaning and preparing the containers as well as adding or providing the appropriate preservatives. Methods of sample preservation are intended to: 1) retard biological action, 2) retard hydrolysis, and 3) reduce sorption effects.

In addition, the collected samples will be thermally preserved by being kept in a refrigerator or iced cooler to cool the samples to a temperature of 0 to 6 degrees Celsius (°C) until received by the laboratory. Care will be taken during sample collection to verify preservatives have been added to containers and the appropriate containers have been supplied. Samples collected during subfreezing temperatures will be protected from freezing.

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Any containers suspected of improper cleaning or preparation will be discarded. Prior to use, the containers will be stored in a clean, dry environment to prevent exposure to fuels, solvents, and other contaminants.

6.1.2 SAMPLE DESIGNATION

The sample designation scheme will provide each sample with a unique number through collection, analysis, data reduction, and validation. Each sample number will consist of the following components: sample location type, sample location (numbered and recorded by GPS location), sample matrix, and monitoring event. The specific samples are designated as follows:

C-KKnn - TT - mmddyy

Where, C designates all samples as associated with the Project with CDOT as the client.

KK is the sample location type:

- DP= Duplicate
- EB= Equipment Blank
- DG=Dewatering groundwater
- SS= Soil Sample
- TB= Trip Blank
- ACM = Potential Asbestos Containing Material
- IF = Import Fill

nn designates the specific sample location:

- For DP prefixes, nn is the sequential duplicate number for that particular sampling event.
- For EB prefixes, nn is the sequential equipment blank number for that particular sampling event.
- For DG, SS, ACM, and IF prefixes, nn is the two-digit number of a sample location.
- For TB prefixes, nn is the sequential trip blank number for that particular sampling event.
- For all designations the nn will be directly recorded to the GPS coordinates of the sample.

TT is the sample matrix or the matrix for which a field or quality control (QC) sample is analyzed:

- AQ = Aqueous
- SL = Soil
- C = Composite

mmddyy represents the two-digit month, day, and year of the sample collection.

For soil samples, the depth in feet below ground surface of the soil sample interval will be recorded as the last part of the sample designation (e.g., 1.5 ft bgs), if applicable. For example, a soil sample collected from an excavation sidewall on April 20, 2018 is labeled C-SS03-SL-042018-3'. An equipment blank collected after taking the soil sample is labeled C-EB01-AQ-042018.

This designation will be placed on each sample container label prior to sample collection. Field duplicate samples and the corresponding primary samples will be clearly identified in the field log and sample

collection records. However, the source of the duplicate samples will not be identified on the chain-of-custody forms or provided to the laboratory.

Samples designated for matrix spikes (MS) and matrix spike duplicates (MSD) are named the same as the original sample and extra volume collected and a note made on the chain of custody indicating they are used for MS/MSDs. The unique sample designations are recorded in the field log. Sample labels are affixed to sample containers sent to the laboratory. To ensure the labels are not dislodged during handling or shipment, clear tape is wrapped around the label and entire bottle. In addition to the unique sample designation, the sample label is completed with the following information:

- Client
- Project name
- Sample collection date and time
- Preservatives
- Sample analyses
- Sampler
- Project and task number

6.1.3 SAMPLE CUSTODY

Chain-of-custody records provide an accurate, written record, which tracks the possession of individual samples from the time of field collection through laboratory receipt and sample analysis. A sample is considered in custody if the sample is in one of the following:

- A person's possession
- View after being in physical possession
- A secure area after having been in physical possession
- A designated secure area, restricted to authorized personnel (e.g., in route via independent courier)

Chains-of-custody are used to document the types of samples collected, the types of preservative used, and analyses requested. Information to be recorded will include:

- Client and Project names
- Samplers' names and signatures
- Unique sample designations
- Sample collection dates and times
- Sample matrices
- Sample analyses
- Number of sample containers per analysis
- Destination of samples (i.e. laboratory name)
- Signatures of individuals involved in custody transfer (including date and time of transfer)
- Tracking number (for independent couriers)

Samples are delivered to laboratories within required hold times and at acceptable temperatures required for proper sample preservation. Chains-of-custody are kept with collected samples and completed as required. Copies of chains-of-custody are maintained by KMP.

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6.1.4 SAMPLE PRESERVATION AND PACKAGING

Samples are preserved in accordance with the analytical method specified for each analysis and sample matrix. The required preservation for each analysis and sample matrix being collected, as determined by the laboratory.

The cooler is packed to limit to potential breakage of sample bottles. Collected samples that require thermal preservation are immediately (within 15 minutes) placed in a cooler with wet ice and maintained at a preservation temperature of 4° Celsius.

Samples are delivered to the laboratory daily, to the extent practicable, for receipt the following day (excluding Sundays), or couriered using a local laboratory-provided courier.

6.1.5 EQUIPMENT CALIBRATION

Detailed information regarding calibration, maintenance, and servicing is provided in the operation manuals that accompany most field instruments.

Field monitoring equipment is calibrated at the beginning of each day before beginning the field efforts and at prescribed intervals thereafter. The frequency of calibration is dependent on the type and stability of the equipment, its intended use, and the recommendations of the manufacturer. Calibration information is recorded in the field log.

Problems with any field-measuring device is recorded in the field log, and, to the extent practicable, spare equipment, parts, and batteries are kept onsite to prevent work disruption.

6.2 FIELD AND LABORATORY QUALITY CONTROL

Field duplicates are used to assess variability in the sample media and the combined sampling and analytical precision; therefore, the results are anticipated to exhibit more variability than that of laboratory duplicates, which measure only laboratory precision. One field duplicate will be collected for the four borings (12 samples) of the same matrix. Duplicate samples are labeled as discussed earlier in this SAP for blind submittal to the laboratory. Precision is evaluated by calculating the relative percent difference (RPD) between the field duplicate sample pairs for all analytes detected at or above the reporting limit. The RPD is not calculated when both duplicate sample results for a field duplicate sample pair are reported as less than the reporting limit, or if one sample is below the reporting limit and both samples agree within two reporting limit increments.

Although the RPD is calculated between field duplicate samples, the result is not used as a basis for qualifying, accepting, or rejecting data. The RPD and actual results are qualitatively evaluated to assess precision of field sample collection procedures. Water field duplicates should have an RPD less than or equal to 50 percent when both the sample and duplicate are greater than or equal to five times the reporting limit; or less than one time the reporting limit, when the sample and/or duplicate is less than five times the reporting limit but greater than the detection limit. Soil field duplicates should have an RPD less than or equal to 100 percent when both the sample and duplicate are greater than or equal to five times the reporting limit; or less than two times the reporting limit, when the sample and/or duplicate is less than five times the reporting limit but greater than the detection limit.

If these criteria are exceeded, then corrective action, such as described in Section 8.0 of this SAP, is taken. Both the primary and duplicate sample data are reported and used for site characterization.

6.3 LABORATORY QUALITY CONTROL SAMPLES

Laboratory QC samples are used to monitor the precision and accuracy of the laboratory's analytical procedure through analysis of QC samples. Typically, laboratory QC samples consist of MS/MSD samples for organic analyses and MS/DS for inorganic analyses.

Matrix spikes measure matrix-specific method performance and are used to assess accuracy and precision. Unlike Lab Control Sample / Lab Control Sample Duplicate (LCS/LCSDs), MS/MSD samples are used to assess the influence of the sample media (media interference) on sample analysis. Samples for MS/MSD analysis are collected from soil and water media. A minimum of one MS/MSD sample pair is analyzed with the 12 samples batch. Each MS/MSD sample is spiked with compounds specified by the laboratory standard operating procedures (SOPs) prior to sample extraction or analysis at a concentration less than or equal to the midpoint of the calibration curve for each analyte. The sample selected for MS/MSD analyses is designated on the chain-of custody form and extra sample volumes will be collected, as necessary, to provide sufficient sample volume for MS/MSD analysis.

MS/MSD percent recovery (%R) results are used to assess the long-term accuracy of a method and the presence or absence of a matrix interference. MS/MSD RPD results are used to assess the precision of the sampling technique and analytical method. MS/MSD results are compared to RD/RA acceptance criteria. If the %R or the RPD between the MS and MSD is outside the limits, all calculations are checked, and the data may be qualified. Sample results are not qualified based solely on MS/MSD results. The results of the MS/MSD analysis are used to determine laboratory accuracy based on the percent of the spiked compounds recovered, and precision by assessing the relative percent differences between matrix spikes and matrix spike duplicates.

The laboratory will, at a minimum, analyze internal QC samples and conduct QC evaluations at the frequency specified by the analytical method, laboratory SOPs, and this SAP. Method-specific QC procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are provided in the laboratory SOPs.

7. Reporting

The data packages for the environmental analyses are Level III, with deliverables similar to those required by the EPA's contract laboratory program. An independent review of environmental analytical laboratory data is conducted to evaluate if the data is of known and documented quality to be used for decision-making. Environmental data generated receives an evaluation of sample-specific parameters for the data packages using guidance from the EPA Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review (January 2017) and the EPA CLP National Functional Guidelines for Organic Data Review (January 2017), method criteria, and laboratory historical limits. The review of sample-specific parameters includes evaluating parameters that are sample related. These include the following if provided in the level of package provided by the laboratory: case narrative comments, chain-of-custody and sample condition upon receipt, holding times, method blank results, surrogate recoveries, laboratory control sample

recoveries, matrix spike recoveries, laboratory duplicate or spike duplicate analysis, post-digestion spike recoveries, serial dilution analysis, internal standard performance, second column confirmation, and results for field quality control samples (e.g. field duplicates, rinsate blanks, and trip blanks). In addition, if requested, laboratory performance parameters may be reviewed for a subset of the data package for tuning, initial calibration, continuing calibration verification, and recalculations performed as applicable to the method.

Upon completion of pre-construction sampling, KMP will provide a summary report of sampling activities. This report will include boring logs, field diary sheets and notes, lab reports, photographs, maps of sample locations, and other applicable detailed information to document and summarize the sampling efforts. This report will be included in the Monthly Statement of RHMs for the applicable month for project records, however the report will also be submitted under separate cover for CCD, CDPHE, and EPA review.

8. Provisions for Corrective Action

A reasonable attempt is made to repair or replace any equipment found to be improperly functioning. If site conditions preclude the use of a specified tool/methodology, the MT notifies KMP and alternate sampling methods are evaluated and employed.

KMP will determine whether field and analytical data or data sets meet the requirements necessary for decision-making. The results of measurements are compared to the DQO requirements set forth in this SAP. As data are evaluated, anomalies in the data or data gaps may become apparent to the data users. The DQOs are considered satisfied if the data are sufficient (based on the quality and completeness of the data) to document environmental media concentrations. Data not meeting data users' needs (if any) are identified and appropriately noted in the project database so the decision-makers are aware of the data limitations.

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— USEPA. 2002. Guidance on Choosing a Sampling Design for Environmental Data Collection.
EPA-240-R-02-005. December.

— USEPA. 2006. "Table 1 - Maximum Concentration of Contaminants for the Toxicity Characteristic," 40 CFR 261.24, amended April 2006.

— USEPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA QA/G-4). USEPA/240/B-05/001, February 2006.

— USEPA. 2014. Sampling and Analysis Plan, Guidance and Template v.4. April.

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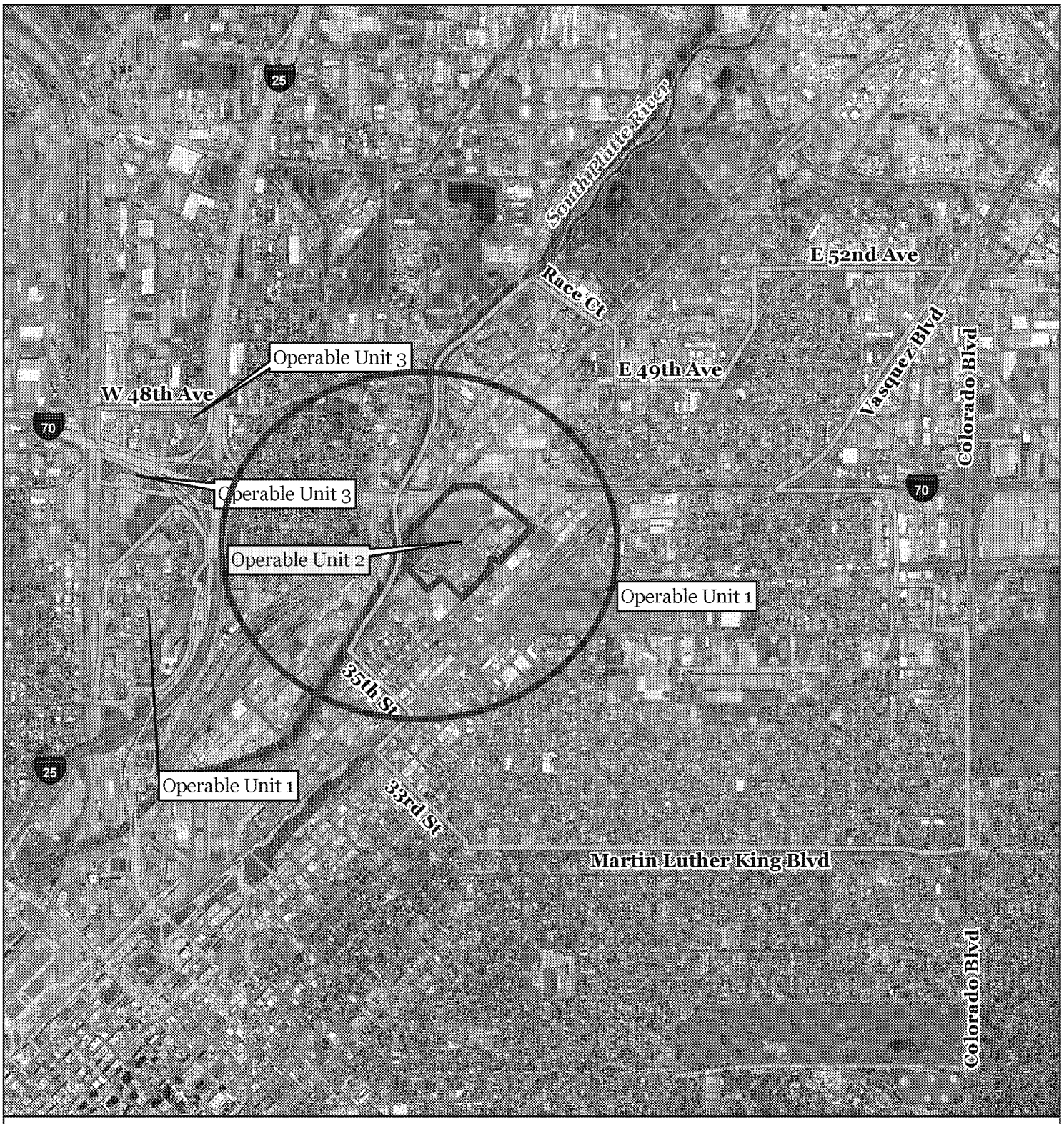
Appendix A

OU2 Area Map & Drawings



Vasquez Blvd. and I-70

Operable Units

Denver County, Colorado

* 1 7 6 9 4 9 2 *

1769492

NPL Boundary

Operable Unit Boundary

*ICs do not exist for this site.

Map Date: January 14, 2011

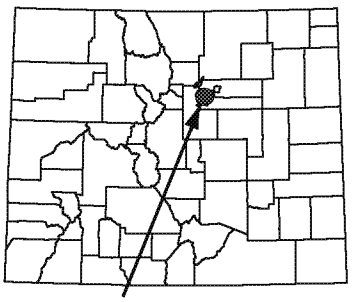
Map Projection: UTM, Meters, 13 North, NAD83

Data Sources: *Boundaries* - U.S. EPA Region 8 (2011); *Imagery* - USDA NAIP 1-meter aerial photo (2009).

0 1,000 2,000 Feet

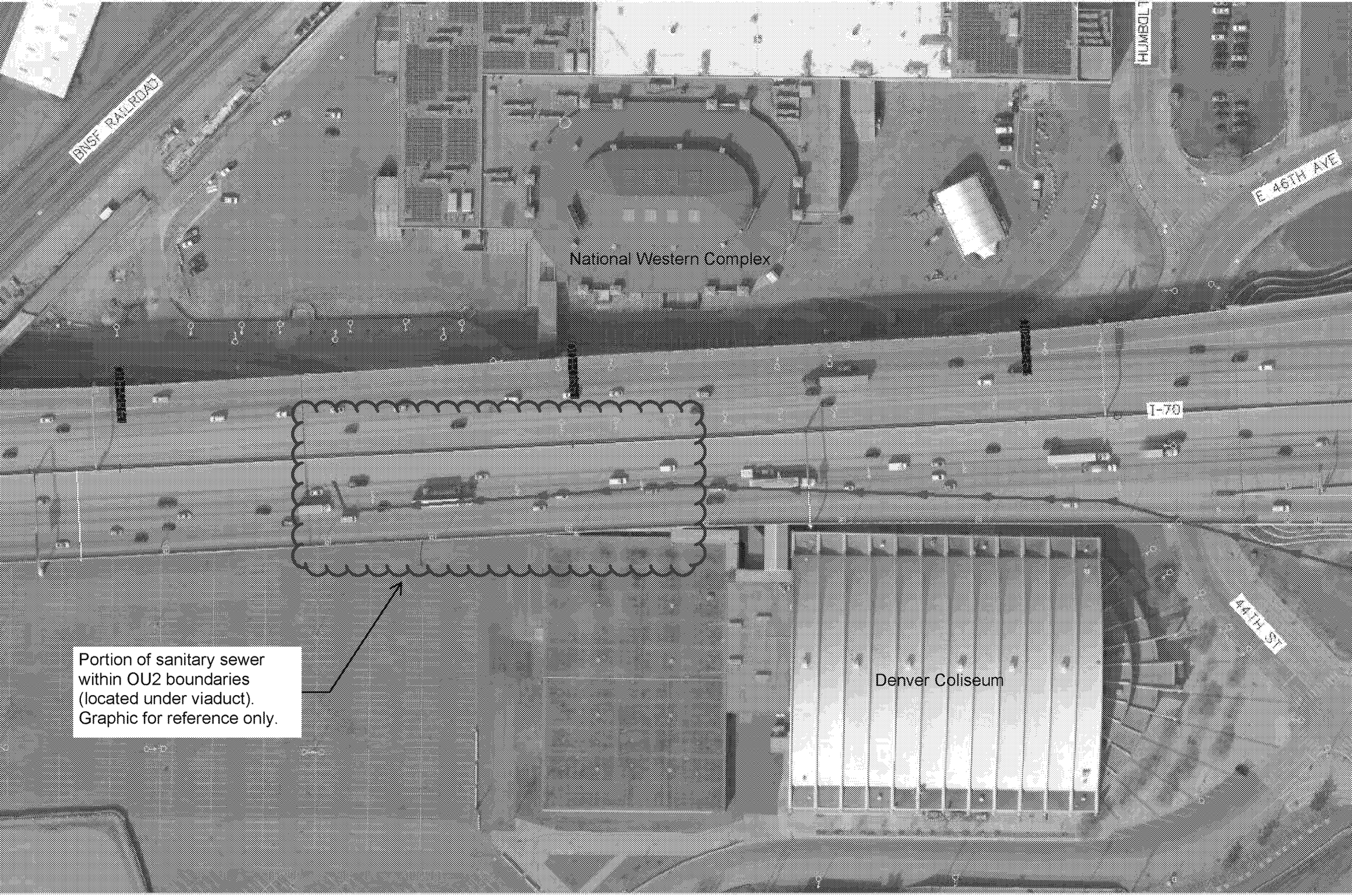
N 0 250 500 Meters

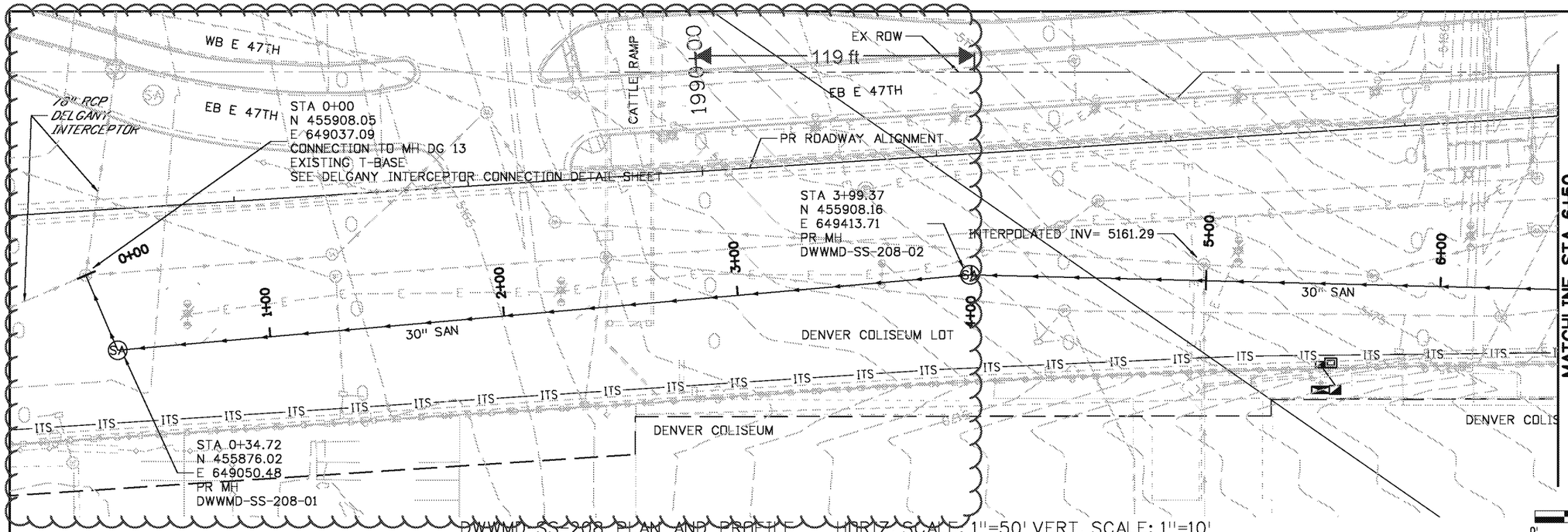
Colorado



Area Enlarged

*Boundaries are based on the nature and extent of contamination and are subject to change.

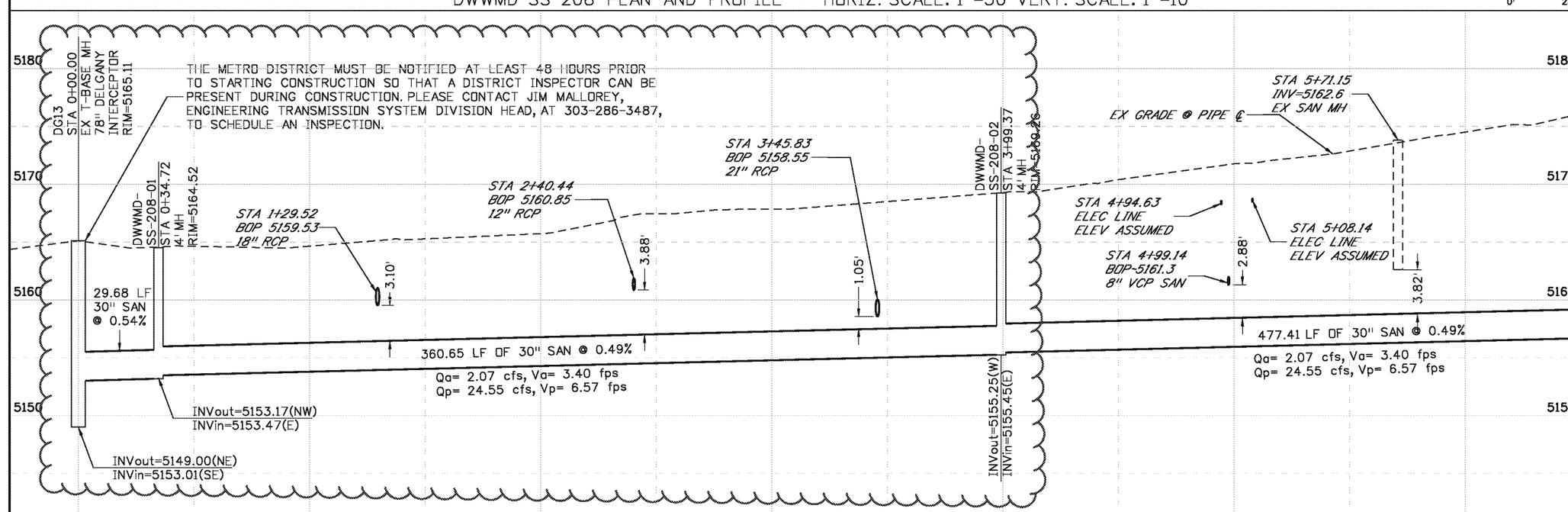

BNSF RAILROAD
National Western Complex
E 46TH AVE
I-70
44TH ST
Denver Coliseum
Portion of sanitary sewer within OU2 boundaries (located under viaduct). Graphic for reference only.



DWWMD-SS-208 PLAN AND PROFILE HORIZ. SCALE: 1"=50' VERT. SCALE: 1"=10'

NOTES:

1. ELEC, GAS, WATER, FIBER OPTIC, TELEPHONE AND OTHER DRY UTILITIES ARE AT ASSUMED ELEVATIONS UNLESS NOTED OTHERWISE
2. LABELS FOR EXISTING FEATURES ARE DISPLAYED IN ITALICS
3. SEE ABANDONMENT SHEETS FOR ABANDONMENT DETAILS OF EXISTING SANITARY
4. PIPE LENGTHS SHOWN IN PROFILE ARE FROM EDGE TO EDGE



Know what's below. Call before you dig.

PRELIMINARY NOT FOR CONSTRUCTION

90% SANITARY

5/17/2018

DWWMD-208_01.dgn

Kiewit meridiam PARTNERS

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation

Region 1

2000 South Holly Street
Denver, CO 80222
Phone: 303-512-4272 FAX: 303-757-9866

KJS

As Constructed

No Revisions:

Revised:

Void:

CENTRAL 70
DWWMD-SS-208
STA 0+00-6+50

Designer: KB
Detailer: KB
Subset: SANITARY 05
Structure Numbers
Subset Sheets: 3 of 10

Project No./Code

FBR 0704-234

19631

Sheet Number SN50.100

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Appendix B

Target Analyte Comparison Criteria

PARAMETER	WASTE CODE	TOTAL* (mg/kg)	TCLP (mg/L)	Media
Metals				
Arsenic	D004	100	<5.05	Water/Soil
Barium	D005	2000	<100.0	Water/Soil
Cadmium	D006	20	<1.0	Water/Soil
Chromium	D007	100	<5.0	Water/Soil
Lead	D008	100	<5.0	Water/Soil
Mercury	D009	4	<0.2	Water/Soil
Selenium	D010	20	<1.0	Water/Soil
Silver	D011	100	<5.0	Water/Soil
VOCs				
Benzene	D018	10	<0.5	Water/Soil
Carbon tetrachloride	D019	10	<0.5	Water/Soil
Chlorobenzene	D021	2000	<100.0	Water/Soil
Chloroform	D022	120	<6.0	Water/Soil
1,1-Dichloroethane	D028	10	<0.5	Water/Soil
1,1-Dichloroethylene	D029	14	<0.7	Water/Soil
Methyl ethyl ketone (MEK)	D035	4000	<200.0	Water/Soil
Tetrachloroethylene	D039	14	<0.7	Water/Soil
Trichloroethylene	D040	10	<0.5	Water/Soil
Vinyl chloride	D043	4	<0.2	Water/Soil
SVOCs				
o-Cresol	D023	4000	<200.0	Water
m-Cresol	D024	4000	<200.0	Water
p-Cresol	D025	4000	<200.0	Water
Cresol, Total	D026	4000	<200.1	Water
1,4-Dichlorobenzene	D027	150	<7.5	Water
2,4-Dinitrotoluene	D030	2.6	<0.13	Water
Hexachlorobenzene	D032	2.6	<0.13	Water
Hexachlorobutadiene	D033	10	<0.5	Water
Hexachloroethane	D034	60	<3.0	Water
Nitrobenzene	D036	40	<2.0	Water
Pentachlorophenol	D037	2000	<100.0	Water
Pyridine	D038	100	<5.0	Water
2,4,5-Trichlorophenol	D041	8000	<400.0	Water
2,4,6-Trichlorophenol	D042	40	<2.0	Water
General				
pH	D002		2.0 < x < 12.5	Water
TS				Water
TSS				Water
Ignitability (liquids only)	D001		>140° F (60° C)	Water
PCBs			<50 mg/kg or ppm	Water
TPH				Water
Asebestos		ND		Soil

*If the TOTAL results are greater than 20 times the TCLP levels, than TCLP must be performed.

ND: Non-detect

Appendix C

Low Flow Groundwater Sampling Procedure

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency – Region 1
11 Technology Drive
North Chelmsford, MA 01863

The controlled version of this document is the electronic version viewed on-line only. If this is a printed copy of the document, it is an uncontrolled version and may or may not be the version currently in use.

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Prepared by:_____ _____
(Robert Reinhart, Quality Assurance Unit) Date

Approved by:_____ _____
(John Smaldone, Quality Assurance Unit) Date

Revision Page

Date	Rev #	Summary of changes	Sections
7/30/96	1	Finalized	
01/19/10	2	Updated	All sections
3/23/17	3	Updated	All sections
9/20/17	4	Updated	Section 7.0

Table of Contents

1.0 USE OF TERMS 4
2.0 SCOPE & APPLICATION 5
3.0 BACKGROUND FOR IMPLEMENTATION 6
4.0 HEALTH & SAFETY 7
5.0 CAUTIONS 7
6.0 PERSONNEL QUALIFICATIONS 9
7.0 EQUIPMENT AND SUPPLIES 9
8.0 EQUIPMENT/INSTRUMENT CALIBRATION 13
9.0 PRELIMINARY SITE ACTIVITIES (as applicable) 13
10.0 PURGING AND SAMPLING PROCEDURE 14
11.0 DECONTAMINATION 19
12.0 FIELD QUALITY CONTROL 21
13.0 FIELD LOGBOOK 21
14.0 DATA REPORT 22
15.0 REFERENCES 22
APPENDIX A 24
PERISTALTIC PUMPS 24
APPENDIX B 25
SUMMARY OF SAMPLING INSTRUCTIONS 25
Low-Flow Setup Diagram 29
APPENDIX C 30
WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM 30

1.0 USE OF TERMS

Equipment blank: The equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank needs only to include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Field duplicates: Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

Indicator field parameters: This SOP uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of when purging operations are sufficient and sample collection may begin.

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program. Consult the laboratory for the sample volume to be collected.

Potentiometric Surface: The level to which water rises in a tightly cased well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

QAPP: Quality Assurance Project Plan

SAP: Sampling and Analysis Plan

SOP: Standard operating procedure

Stabilization: A condition that is achieved when all indicator field parameter measurements are sufficiently stable (as described in the "Monitoring Indicator Field Parameters" section) to allow sample collection to begin.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site and returned to the laboratory. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

2.0 SCOPE & APPLICATION

The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This standard operating procedure (SOP) for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

The SOP emphasizes the need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging in order to determine when sample collection may begin. Samples properly collected using this SOP are suitable for analysis of groundwater contaminants (volatile and semi-volatile organic analytes, dissolved gases, pesticides, PCBs, metals and other inorganics), or naturally occurring analytes. This SOP is based on Puls, and Barcelona (1996).

This procedure is designed for monitoring wells with an inside diameter (1.5-inches or greater) that can accommodate a positive lift pump with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval"). This SOP is not applicable to other well-sampling conditions.

While the use of dedicated sampling equipment is not mandatory, dedicated pumps and tubing can reduce sampling costs significantly by streamlining sampling activities and thereby reducing the overall field costs.

The goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help to minimize sampling variability.

This procedure describes a general framework for groundwater sampling. Other site specific information (hydrogeological context, conceptual site model (CSM), DQOs, etc.) coupled with systematic planning must be added to the procedure in order to develop an appropriate site specific SAP/QAPP. In addition, the site specific SAP/QAPP must identify the specific equipment that will be used to collect the groundwater samples.

This procedure does not address the collection of water or free product samples from wells containing free phase LNAPLs and/or DNAPLs (light or dense non-aqueous phase

liquids). For this type of situation, the reader may wish to check: Cohen, and Mercer (1993) or other pertinent documents.

This SOP is to be used when collecting groundwater samples from monitoring wells at all Superfund, Federal Facility and RCRA sites in Region 1 under the conditions described herein. Request for modification of this SOP, in order to better address specific situations at individual wells, must include adequate technical justification for proposed changes. All changes and modifications must be approved and included in a revised SAP/QAPP before implementation in field.

3.0 BACKGROUND FOR IMPLEMENTATION

It is expected that the monitoring well screen has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, and operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake. For new wells, or for wells without pump intake depth information, the site's SAP/QAPP must provide clear reasons and instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected. If the depths to top and bottom of the well screen are not known, the SAP/QAPP will need to describe how the sampling depth will be determined and how the data can be used.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU, and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection

may still take place provided the indicator field parameter criteria in this procedure are met. If after 2 hours of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization), c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore, the data may not meet the data quality objectives of the sampling event).

It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell needs to be used to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

4.0 HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

5.0 CAUTIONS

The following cautions need to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture along the sampling tubing, and squeezing/pinching the pump's tubing which results in a pressure change.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in

the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem when using a centrifugal pump or peristaltic pump.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., dissolved oxygen meter, etc.) can result in faulty data being collected.

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby).

Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely checked to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exist) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be needed.

6.0 PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. OSHA regulations may require the sampler to take the 40 hour OSHA health and safety training course and a refresher course prior to engaging in any field activities, depending upon the site and field conditions.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with, the site Health and Safety Plan, all relevant SOPs, and SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

7.0 EQUIPMENT AND SUPPLIES

A. Informational materials for sampling event

A copy of the current Health and Safety Plan, SAP/QAPP, monitoring well construction data, location map(s), field data from last sampling event, manuals for sampling, and the monitoring instruments' operation, maintenance, and calibration manuals should be brought to the site.

B. Well keys.

C. Extraction device

Adjustable rate, submersible pumps (e.g., centrifugal, bladder, etc.) which are constructed of stainless steel or polytetrafluoroethylene (PTFE, i.e. Teflon®) are preferred. PTFE, however, should not be used when sampling for per- and polyfluoroalkyl substances (PFAS) as it is likely to contain these substances.

Note: If extraction devices constructed of other materials are to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

If bladder pumps are selected for the collection of VOCs and dissolved gases, the pump setting should be set so that one pulse will deliver a water volume that is sufficient to fill a 40 mL VOC vial. This is not mandatory, but is considered a "best practice". For the proper operation, the bladder pump will need a minimum amount of water above the pump; consult the manufacturer for the recommended submergence. The pump's recommended submergence value should be determined during the planning stage, since it may influence well construction and placement of dedicated pumps where water-level fluctuations are significant.

Adjustable rate, peristaltic pumps (suction) are to be used with caution when collecting samples for VOCs and dissolved gases (e.g., methane, carbon dioxide, etc.) analyses. Additional information on the use of peristaltic pumps can be found in Appendix A. If peristaltic pumps are used, the inside diameter of the rotor head tubing needs to match the inside diameter of the tubing installed in the monitoring well.

Inertial pumping devices (motor driven or manual) are not recommended. These devices frequently cause greater disturbance during purging and sampling, and are less easily controlled than submersible pumps (potentially increasing turbidity and sampling variability, etc.). This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

D. Tubing

PTFE (Teflon®) or PTFE-lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. As discussed in the previous section, PTFE tubing should not be used when sampling for PFAS. In this case, a suitable alternative such as high-density polyethylene tubing should be used.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for metal and other inorganics analyses.

Note: If tubing constructed of other materials is to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

The use of 1/4 inch or 3/8 inch (inside diameter) tubing is recommended. This will help ensure that the tubing remains liquid filled when operating at very low pumping rates when using centrifugal and peristaltic pumps.

Silastic tubing should be used for the section around the rotor head of a peristaltic pump. It should be less than a foot in length. The inside diameter of the tubing used at the pump rotor head must be the same as the inside diameter of tubing placed in the well. A tubing connector is used to connect the pump rotor head tubing to the well tubing. Alternatively, the two pieces of tubing can be connected to each other by placing the one end of the tubing inside the end of the other tubing. The tubing must not be reused.

E. The water level measuring device

Electronic "tape", pressure transducer, water level sounder/level indicator, etc. should be capable of measuring to 0.01 foot accuracy. Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each sampling event.

F. Flow measurement supplies

Graduated cylinder (size according to flow rate) and stopwatch usually will suffice.

Large graduated bucket used to record total water purged from the well.

G. Interface probe

To be used to check on the presence of free phase liquids (LNAPL, or DNAPL) before purging begins (as needed).

H. Power source (generator, nitrogen tank, battery, etc.)

When a gasoline generator is used, locate it downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate samples.

I. Indicator field parameter monitoring instruments

Use of a multi-parameter instrument capable of measuring pH, oxidation/reduction potential (ORP), dissolved oxygen (DO), specific conductance, temperature, and coupled with a flow-through-cell is required when measuring all indicator field parameters, except turbidity. Turbidity is collected using a separate instrument. Record equipment/instrument identification (manufacturer, and model number).

Transparent, small volume flow-through-cells (e.g., 250 mLs or less) are preferred. This allows observation of air bubbles and sediment buildup in the cell, which can interfere with the operation of the monitoring instrument probes, to be easily detected. A small volume

cell facilitates rapid turnover of water in the cell between measurements of the indicator field parameters.

It is recommended to use a flow-through-cell and monitoring probes from the same manufacturer and model to avoid incompatibility between the probes and flow-through-cell.

Turbidity samples are collected before the flow-through-cell. A "T" connector coupled with a valve is connected between the pump's tubing and flow-through-cell. When a turbidity measurement is required, the valve is opened to allow the groundwater to flow into a container. The valve is closed and the container sample is then placed in the turbidimeter.

Standards are necessary to perform field calibration of instruments. A minimum of two standards are needed to bracket the instrument measurement range for all parameters except ORP which use a Zobell solution as a standard. For dissolved oxygen, a wet sponge used for the 100% saturation and a zero dissolved oxygen solution are used for the calibration.

Barometer (used in the calibration of the Dissolved Oxygen probe) and the conversion formula to convert the barometric pressure into the units of measure used by the Dissolved Oxygen meter are needed.

J. Decontamination supplies

Includes (for example) non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.

K. Record keeping supplies

Logbook(s), well purging forms, chain-of-custody forms, field instrument calibration forms, etc.

L. Sample bottles

M. Sample preservation supplies (as required by the analytical methods)

N. Sample tags or labels

O. PID or FID instrument

If appropriate, to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

P. Miscellaneous Equipment

Equipment to keep the sampling apparatus shaded in the summer (e.g., umbrella) and from freezing in the winter. If the pump's tubing is allowed to heat up in the warm weather, the cold groundwater may degas as it is warmed in the tubing.

8.0 EQUIPMENT/INSTRUMENT CALIBRATION

Prior to the sampling event, perform maintenance checks on the equipment and instruments according to the manufacturer's manual and/or applicable SOP. This will ensure that the equipment/instruments are working properly before they are used in the field.

Prior to sampling, the monitoring instruments must be calibrated and the calibration documented. The instruments are calibrated using U.S Environmental Protection Agency Region 1 *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017, or latest version or from one of the methods listed in 40CFR136, 40CFR141 and SW-846.

The instruments shall be calibrated at the beginning of each day. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range. At the end of each day, a calibration check is performed to verify that instruments remained in calibration throughout the day. This check is performed while the instrument is in measurement mode, not calibration mode. If the field instruments are being used to monitor the natural attenuation parameters, then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration. Note: during the day if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only), this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation occurs the data from this instrument will need to be qualified or rejected.

9.0 PRELIMINARY SITE ACTIVITIES (as applicable)

Check the well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted).

If needed, lay out a sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, etc.).

Remove well cap and if appropriate measure VOCs at the rim of the well with a PID or FID instrument and record reading in field logbook or on the well purge form.

If the well casing does not have an established reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook (consider a photographic record as well). All water level measurements must be recorded relative to this reference point (and the altitude of this point should be determined using techniques that are appropriate to site's DQOs.

If water-table or potentiometric surface map(s) are to be constructed for the sampling event, perform synoptic water level measurement round (in the shortest possible time) before any purging and sampling activities begin. If possible, measure water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) the day before sampling begins, in order to allow for re-settlement of any particulates in the water column. This is especially important for those wells that have not been recently sampled because sediment buildup in the well may require the well to be redeveloped. If measurement of total well depth is not made the day before, it should be measured after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe may not be necessary unless analytical data or field analysis signal a worsening situation. This SOP cannot be used in the presence of LNAPLs or DNAPLs. If NAPLs are present, the project team must decide upon an alternate sampling method. All project modifications must be approved and documented prior to implementation.

If available check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). If changes are made in the intake depth or extraction rate(s) used during previous sampling event(s), for either portable or dedicated extraction devices, record new values, and explain reasons for the changes in the field logbook.

10.0 PURGING AND SAMPLING PROCEDURE

Purging and sampling wells in order of increasing chemical concentrations (known or anticipated) are preferred.

The use of dedicated pumps is recommended to minimize artificial mobilization and entrainment of particulates each time the well is sampled. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

A. Initial Water Level

Measure the water level in the well before installing the pump if a non-dedicated pump is being used. The initial water level is recorded on the purge form or in the field logbook.

B. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the appropriate depth (may not be the mid-point of the screen/open interval). The Sampling and Analysis Plan/Quality Assurance Project Plan should specify the sampling depth (used previously), or provide criteria for selection of intake depth for each new well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well.

Pump tubing lengths, above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

C. Measure Water Level

Before starting pump, measure water level. Install recording pressure transducer, if used to track drawdowns, to initialize starting condition.

D. Purge Well

From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. This information is recorded on the purge form or in the field logbook.

Start the pump at low speed and slowly increase the speed until discharge occurs. Check water level. Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. If the

minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging.

Monitor and record the water level and pumping rate every five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. If the initial water level is above the top of the screen do not allow the water level to fall into the well screen. The final purge volume must be greater than the stabilized drawdown volume plus the pump's tubing volume. If the drawdown has exceeded 0.3 feet and stabilizes, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

Avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples.

Note: the flow rate used to achieve a stable pumping level should remain constant while monitoring the indicator parameters for stabilization and while collecting the samples.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (e.g., bladder, peristaltic), and/or the use of dedicated equipment. For new monitoring wells, or wells where the following situation has not occurred before, if the recovery rate to the well is less than 50 mL/min., or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. The project manager or field team leader will need to make the decision when samples should be collected, how the sample is to be collected, and the reasons recorded on the purge form or in the field logbook. A water level measurement needs to be performed and recorded before samples are collected. If the project manager decides to collect the samples using the pump, it is best during this recovery period that the pump intake tubing not be removed, since this will aggravate any turbidity problems. Samples in this specific situation may be collected without stabilization of indicator field parameters. Note that field conditions and efforts to overcome problematic situations must be recorded in order to support field decisions to deviate from normal procedures described in this SOP. If this type of problematic situation persists in a well, then water sample collection should be

changed to a passive or no-purge method, if consistent with the site's DQOs, or have a new well installed.

E. Monitor Indicator Field Parameters

After the water level has stabilized, connect the "T" connector with a valve and the flow-through-cell to monitor the indicator field parameters. If excessive turbidity is anticipated or encountered with the pump startup, the well may be purged for a while without connecting up the flow-through-cell, in order to minimize particulate buildup in the cell (This is a judgment call made by the sampler). Water level drawdown measurements should be made as usual. If possible, the pump may be installed the day before purging to allow particulates that were disturbed during pump insertion to settle.

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) at a frequency of five minute intervals or greater. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 mLs/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell it would be every ten minutes). If the cell volume cannot be replaced in the five minute interval, then the time between measurements must be increased accordingly. Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments followed by stabilization of indicator parameters. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Samples for turbidity measurements are obtained before water enters the flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and

continue monitoring activities. Record start and stop times and give a brief description of cleaning activities.

The flow-through-cell must be designed in a way that prevents gas bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see Appendix B Low-Flow Setup Diagram). Throughout the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must remain submerged in water at all times.

F. Collect Water Samples

When samples are collected for laboratory analyses, the pump's tubing is disconnected from the "T" connector with a valve and the flow-through-cell. The samples are collected directly from the pump's tubing. Samples must not be collected from the flow-through-cell or from the "T" connector with a valve.

VOC samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the pump's flow rate is too high to collect the VOC/dissolved gases samples, collect the other samples first. Lower the pump's flow rate to a reasonable rate and collect the VOC/dissolved gases samples and record the new flow rate.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use the following procedure to collect samples: collect non-VOC/dissolved gases samples first, then increase flow rate slightly until the water completely fills the tubing, collect the VOC/dissolved gases samples, and record new drawdown depth and flow rate.

For bladder pumps that will be used to collect VOC or dissolved gas samples, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL VOC vial.

Use pre-preserved sample containers or add preservative, as required by analytical methods, to the samples immediately after they are collected. Check the analytical methods

(e.g. EPA SW-846, 40 CFR 136, water supply, etc.) for additional information on preservation.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter (transparent housing preferred) is required, and the filter size (0.45 µm is commonly used) should be based on the sampling objective. Pre-rinse the filter with groundwater prior to sample collection. Make sure the filter is free of air bubbles before samples are collected. Preserve the filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health or ecological risk calculations.

Label each sample as collected. Samples requiring cooling will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

G. Post Sampling Activities

If a recording pressure transducer is used to track drawdown, re-measure water level with tape.

After collection of samples, the pump tubing may be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth annually is usually sufficient after the initial low stress sampling event. However, a greater frequency may be needed if the well has a "silting" problem or if confirmation of well identity is needed.

Secure the well.

11.0 DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well, and then following sampling of each subsequent well. Pumps should not be removed between purging and sampling operations. The pump, tubing, support cable and electrical wires which were in contact with the well should be decontaminated by one of the procedures listed below.

The use of dedicated pumps and tubing will reduce the amount of time spent on decontamination of the equipment. If dedicated pumps and tubing are used, only the initial sampling event will require decontamination of the pump and tubing.

Note if the previous equipment blank data showed that contaminant(s) were present after using the below procedure or the one described in the SAP/QAPP, a more vigorous procedure may be needed.

Procedure 1

Decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump and tubing. The pump may be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Optional - flush with isopropyl alcohol (pesticide grade; must be free of ketones {e.g., acetone}) or with methanol. This step may be required if the well is highly contaminated or if the equipment blank data from the previous sampling event show that the level of contaminants is significant.

Flush with distilled/deionized water. This step must remove all traces of alcohol (if used) from the equipment. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

12.0 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. Quality control samples include field duplicates, equipment blanks, matrix spike/matrix spike duplicates, trip blanks (VOCs), and temperature blanks.

13.0 FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities (see Appendix C, example table), and record the following for each well:

Site name, municipality, state.

Well identifier, latitude-longitude or state grid coordinates.

Measuring point description (e.g., north side of PVC pipe).

Well depth, and measurement technique.

Well screen length.

Pump depth.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.

Type of tubing used and its length.

Type of pump used.

Clock time of start and end of purging and sampling activity.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analyses.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions, including approximate ambient air temperature.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling/monitoring equipment used, including trade names, model number, instrument identification number, diameters, material composition, etc.

14.0 DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, field indicator parameters measured during purging, field instrument calibration information, and whatever other field logbook information is needed to allow for a full evaluation of data usability.

Note: the use of trade, product, or firm names in this sampling procedure is for descriptive purposes only and does not constitute endorsement by the U.S. EPA.

15.0 REFERENCES

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U.S Environmental Protection Agency, EPA SW-846.

U.S Environmental Protection Agency, 40 CFR 136.

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Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, Influence of Dissolved Oxygen Convection on Well Sampling, *Ground Water Monitoring & Remediation* 27, no. 3: 49-58.

APPENDIX A

PERISTALTIC PUMPS

Before selecting a peristaltic pump to collect groundwater samples for VOCs and/or dissolved gases, (e.g., methane, carbon dioxide, etc.) consideration should be given to the following:

- The decision of whether or not to use a peristaltic pump is dependent on the intended use of the data.
- If the additional sampling error that may be introduced by this device is NOT of concern for the VOC/dissolved gases data's intended use, then this device may be acceptable.
- If minor differences in the groundwater concentrations could affect the decision, such as to continue or terminate groundwater cleanup or whether the cleanup goals have been reached, then this device should NOT be used for VOC/dissolved gases sampling. In these cases, centrifugal or bladder pumps are a better choice for more accurate results.

EPA and USGS have documented their concerns with the use of the peristaltic pumps to collect water sample in the below documents.

- "Suction Pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.
- "The agency does not recommend the use of peristaltic pumps to sample ground water particularly for volatile organic analytes" *RCRA Ground-Water Monitoring Draft Technical Guidance*, EPA Office of Solid Waste, November 1992.
- "The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and volatiles loss", *Low-flow (Minimal drawdown) Ground-Water Sampling Procedures*, by Robert Puls & Michael Barcelona, April 1996, EPA/540/S-95/504.
- "Suction-lift pumps, such as peristaltic pumps, can operate at a very low pumping rate; however, using negative pressure to lift the sample can result in the loss of volatile analytes", USGS Book 9 Techniques of Water-Resources Investigation, Chapter A4. (Version 2.0, 9/2006).

APPENDIX B

SUMMARY OF SAMPLING INSTRUCTIONS

These instructions are for using an adjustable rate, submersible pump or a peristaltic pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. The water level in the monitoring well is above the top of the well screen or open interval, the ambient temperature is above 32°F, and the equipment is not dedicated. Field instruments are already calibrated. The equipment is setup according to the diagram at the end of these instructions.

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of screen/open interval).

2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, lay out a sheet of polyethylene around the well (if necessary), and setup the equipment. If necessary a canopy or an equivalent item can be setup to shade the pump's tubing and flow-through-cell from the sun light to prevent the sun light from heating the groundwater.

3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.

4. Install the pump's intake to the appropriate depth (e.g., midpoint) of the well screen or open interval. Do not turn-on the pump at this time.

5. Measure water level and record this information.

6. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen.

If the groundwater is highly turbid or discolored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or discolored water is usually from the well-being disturbed during the pump installation. If the water does not clear, then you need to make a choice whether to continue purging the well (hoping that it will clear after a reasonable time) or continue to

the next step. Note, it is sometimes helpful to install the pump the day before the sampling event so that the disturbed materials in the well can settle out.

If the water level drops to the top of the well screen during the purging of the well, stop purging the well, and do the following:

> Wait for the well to recharge to a sufficient volume so samples can be collected. This may take a while (pump may be removed from well, if turbidity is not a problem). The project manager will need to make the decision when samples should be collected and the reasons recorded in the site's log book. A water level measurement needs to be performed and recorded before samples are collected. When samples are being collected, the water level must not drop below the top of the screen or open interval. Collect the samples from the pump's tubing. Always collect the VOCs and dissolved gases samples first. Normally, the samples requiring a small volume are collected before the large volume samples are collected just in case there is not sufficient water in the well to fill all the sample containers. All samples must be collected, preserved, and stored according to the analytical method. Remove the pump from the well and decontaminate the sampling equipment.

If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 7. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

7. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes and allow the gas bubbles to exit the cell easily (see Low-Flow Setup Diagram). Note:

make sure there are no gas bubbles caught in the probes' protective guard; you may need to shake the cell to remove these bubbles.

8. Turn-on the monitoring probes and turbidity meter.

9. Record the temperature, pH, dissolved oxygen, specific conductance, and oxidation/reduction potential measurements. Open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, do the measurement, and record this measurement. Calculate the pump's flow rate from the water exiting the flow-through-cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them.

10. Repeat Step 9 every 5 minutes or as appropriate until monitoring parameters stabilized. Note: at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within the following limits:

Turbidity (10% for values greater than 5 NTUs; if three Turbidity values are less than 5 NTUs, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

If these stabilization requirements do not stabilize in a reasonable time, the probes may have been coated from the materials in the groundwater, from a buildup of sediment in the flow-through-cell, or a gas bubble is lodged in the probe. The cell and the probes will need to be cleaned. Turn-off the probes (not the pump), disconnect the cell from the "T" connector and continue to purge the well. Disassemble the cell, remove the sediment, and clean the probes according to the manufacturer's instructions. Reassemble the cell and connect the cell to the "T" connector. Remove all gas bubbles from the cell, turn-on the probes, and continue the measurements. Record the time the cell was cleaned.

11. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. If you are using a centrifugal or peristaltic pump check the pump's tubing to determine if the tubing is completely filled with water (no air space).

All samples must be collected and preserved according to the analytical method. VOCs and dissolved gases samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

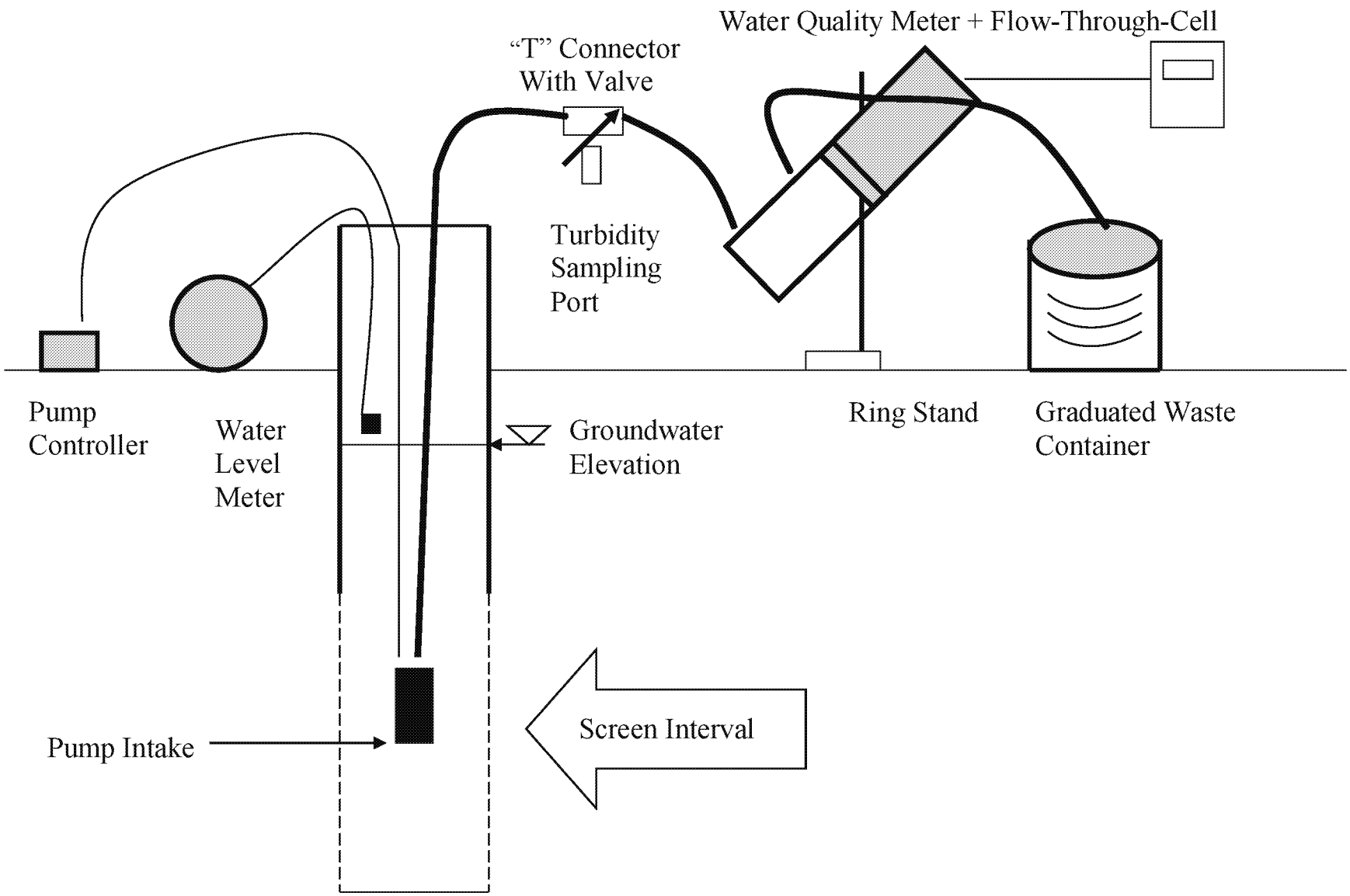
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

> All samples must be collected and preserved according to the analytical method. The VOCs and the dissolved gases (e.g., methane, ethane, ethene, and carbon dioxide) samples are collected last. When it becomes time to collect these samples increase the pump's flow rate until the tubing is completely filled. Collect the samples and record the new flow rate.

12. Store the samples according to the analytical method.

13. Record the total purged volume (graduated waste bucket). Remove the pump from the well and decontaminate the sampling equipment.

Low-Flow Setup Diagram



APPENDIX C

EXAMPLE (Minimum Requirements)

WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

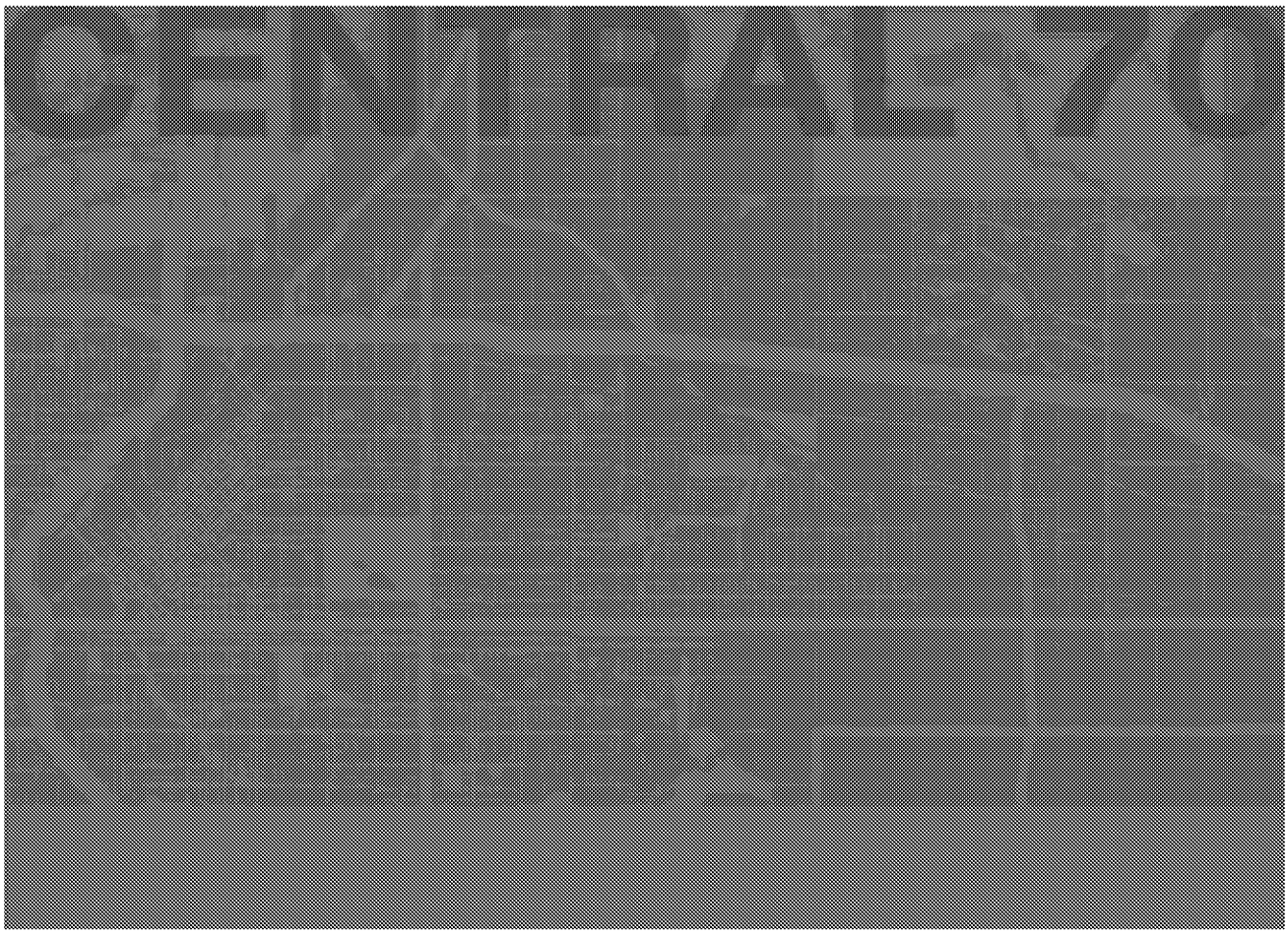
Location (Site/Facility Name)_____
Well Number_____ Date_____
Field Personnel_____
Sampling Organization_____
Identify MP_____

Depth to _____/_____ of screen
(below MP) top bottom
Pump Intake at (ft. below MP)_____
Purging Device; (pump type)_____
Total Volume Purged _____

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. "C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Tur-bidity NTU	Comments
Stabilization Criteria					3%	3%	±0.1	±10 mv	10%	10%	

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25°C.
3. Oxidation reduction potential (ORP)

Attachment 5: Health and Safety Plan



Kiewit meridiam
PARTNERS

HEALTH AND SAFETY PLAN

CENTRAL 70, DENVER, CO

RECORD OF REVISIONS

Revision number	Date issued	Pages affected	Comments
0	04/27/2018	All	Initial Submission
1	06/01/2018	All	Revised per CDOT comments
2	08/27/2018	11-12,15,20,25-26,29,30,32-35,37,38	Revised
3	10/03/2018	6,8,11-12,15-16,20,25-26,29,30,32-35,37,38	Revised
4	05/08/2019	All	Annual update
5	06/05/2019	10, 20, & Attachment J	Revised per CDOT comments
6	06/22/2019	All Appendix references	Re-numbered appendices per CDOT comments

ED_002842A_00000589-00236

TABLE OF CONTENTS

1 Introduction 6
1.1 GENERAL SITE INFORMATION 7
1.2 BACKGROUND AND SITE HISTORY 7
1.2.1 CHEMICALS OF CONCERN 8
1.2.2 COMPLIANCE REQUIREMENTS 9
2 Organization Structure 10
2.1.1 PROJECT AND TASK MANAGERS 11
2.1.2 SITE HEALTH AND SAFETY COORDINATOR 11
2.1.3 MONITORING TECHNICIAN (MT) 13
2.1.4 FIELD TEAM 14
3 Description of Planned Activities 14
3.1 CENTRAL 70 RECONSTRUCTION WORK 14
3.2 DEMOLITION OF EXISTING VIADUCT AND BRIDGE STRUCTURES 16
3.3 HAZARDOUS BUILDING MATERIAL SAMPLING 17
3.4 ABATEMENT OF HAZARDOUS BUILDING MATERIALS 17
4 Job Hazard Analysis 18
4.1 CHEMICAL HAZARDS 19
4.1.1 HAZARD CONTROLS 20
4.1.2 CHEMICAL AND METAL CONSTITUENTS 20
4.1.3 ASBESTOS CONTAINING MATERIAL 20
4.1.4 LEAD AND HEAVY METAL BASED PAINT 21
4.1.5 RESPIRABLE CYSTALLINE SILICA 21
4.1.6 METHANE AND LANDFILL GASES 22
4.2 PHYSICAL HAZARDS 23
4.2.1 HAZARD CONTROLS 24
5 Personal Protective Equipment 26
5.1 LEVEL OF PROTECTION 26
5.2 LEVEL D AND MODIFIED LEVEL D 27
5.3 LEVEL C 27
5.4 UPGRADING/DOWNGRADING 28
5.5 INSPECTION 28
6 First Aid and Safety Equipment 28
7 Air Monitoring 29

ED_002842A_00000589-00237

7.1 PARTICULATES 30
7.2 EXPLOSIVE VAPORS AND OXYGEN DEFICIENT ATMOSPHERES 30
8 Site Controls and Decontamination 31
8.1 LONE WORKING 32
8.2 SITE/FACILITY ENTRY 32
8.3 SITE COMMUNICATION 32
8.3.1 DAILY HEALTH AND SAFETY BRIEFING 32
8.3.2 LONE WORKING 32
8.4 DECONTAMINATION 33
8.4.1 EQUIPMENT 33
8.4.2 PERSONNEL 33
8.5 CONFINED SPACE ENTRY 33
9 Emergency Procedures 34
9.1 PERSONNEL ROLES AND LINES OF AUTHORITY 34
9.2 EVACUATION ROUTES AND PROCEDURES 34
9.3 EMERGENCY CONTACTS 34
9.4 EMERGENCY MEDICAL TREATMENT PROCEDURES 35
9.5 CHEMICAL EXPOSURE EMERGENCIES 36
9.5.1 CHEMICAL EXPOSURE 36
9.6 FIRE PROTECTION 36
9.7 PERSONAL PROTECTIVE EQUIPMENT FAILURE 36
9.8 OTHER EQUIPMENT FAILURE 37
10 Accident and Incident Reporting 37
11 Safety and Health Training Program 37
11.1 HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE TRAINING 37
11.2 FIRST AID 38
11.3 ASBESTOS AWARENESS TRAINING 38
11.4 SITE SPECIFIC TRAINING 38
11.5 VISITOR TRAINING 39
12 Medical Surveillance 39
12.1 BASELINE PHYSICAL EXAMINATION 39
12.2 ANNUAL PHYSICAL EXAMINATION 40
12.3 RETURN TO WORK EXAMINATION 41

ED_002842A_00000589-00238

12.4 EXIT PHYSICAL EXAMINATION 41
12.5 OTHER EXAMINATIONS 42
12.6 MEDICAL RECORDS 42
13 Certification and Signatures 43
14 Acronyms 44
15 References 46

TABLES

Table 2.1 Project Personnel Contact Information **10**
Table 7.1 VOC Air Monitoring Action Levels **30**
Table 7.2 Landfill Gas Air Monitoring Action Levels **31**
Table 9.1 Emergency Contact Information **35**
Table 13.1 HASP Certifications **43**

FIGURES

FIGURE 1 SITE LOCATION MAP

APPENDICES

APPENDIX A UTILITY LOCATION AND PROTECTION PROCEDURES
APPENDIX B FIELD STANDARD OPERATING PROCEDURES
APPENDIX C HEAT AND COLD STRESS MONITORING AND PREVENTION
APPENDIX D JOB HAZARD ANALYSIS
APPENDIX E NIOSH POCKET GUIDE TO CHEMICAL HAZARDS
APPENDIX F ROUTE TO HOSPITAL
APPENDIX G METHAMPHETAMINE DRUG LAB DISCOVERY
APPENDIX H KIEWIT CONFINED SPACE ENTRY PROGRAM
APPENDIX I PROJECT AGREEMENT SPECIAL PROCEDURES 250 SPECIFICATION
APPENDIX J MANAGEMENT OF STRUCTURES WITH LEAD AND HEAVY METAL PAINT

ED_002842A_00000589-00239

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_____

Megan Wood

Kiewit Meridiam Partners. Environmental Project Manager

This Health and Safety Plan was prepared by FEI on behalf of Kiewit Meridiam Partners (KMP), in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects KMP's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. KMP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

The original of the technology-based document sent herewith has been authenticated and will be retained by KMP for a minimum of ten years. Since the file transmitted is now out of KMP's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

1 Introduction

This Health and Safety Plan (HASP) was prepared to address potential health and safety issues that may arise during the construction phase of the Central 70 project with regard to environmental and subsurface work including trenching and excavations, caisson drilling, potholing activities, soil sampling, test pit excavation, demolition of existing structures and hazardous materials sampling at the Central I-70 Project located in Denver, Colorado (Figure 1). In addition, after construction is complete there is a 30-year operations and maintenance term associated with the Central I-70 project.

In this HASP, the term "Site" is used to denote the entire Central I-70 Project corridor where Kiewit Meridiam Partners (KMP), the Developer, Kiewit Infrastructure Co. (KIC), the construction contractor, and their subcontractors will conduct construction activities.

This HASP provides an overview of conditions at the Site and describes the safety procedures to be employed during implementation of the construction phase and operation phase of the project. Construction phase includes environmental and subsurface work, trenching and excavations, caisson drilling, potholing activities, soil sampling, demolition of existing structures and hazardous materials sampling. The Operation phase of the project includes operations and maintenance (O&M) of existing infrastructure within the O&M limits during construction including the I-70 Mainline and associated infrastructure, local agency infrastructure, drainage, water quality, ITS and electronic toll collection facilities, utility services, traffic signals, lighting, railway structures, fencing, snow and ice control services.

The HASP presents the minimum requirements applicable to all KMP and KIC employees and their subcontractors. All subcontractors are required to implement this HASP and may use more stringent requirements as necessary to fulfill their own corporate health and safety requirements for compliance with OSHA regulations under 29 CFR 1926. This HASP is also written in accordance with the Project Agreement Special Provision 250 specification (included as Appendix I).

During the development of this HASP, consideration was given to current safety standards, as defined by the U.S. Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the American Conference of Governmental Industrial Hygienists (ACGIH), the National Institute for Occupational Safety and Health (NIOSH), the Colorado Department of Public Health and Environment (CDPHE), KMP and KIC. In addition, the HASP includes information on health effects and standards for known contaminants and the procedures designed to account for the potential for exposure to unknown substances. Specifically, the following references have been consulted:

- 29 CFR 1926, OSHA Construction Standard
- 29 CFR 1926.59, Hazard Communication Standard
- 29 CFR 1910.120 and 29 CFR 1926.65, Hazardous Waste Operations and Emergency Response
- EPA 40 CFR Protection of the Environment
- NIOSH Pocket Guide to Chemical Hazards
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values
- Quick Selection Guide to Chemical Protective Clothing
- Ansell Resistance Guide Permeation and Degradation for Gloves and Protective Clothing

ED_002842A_00000589-00241

1.1 GENERAL SITE INFORMATION

The Central 70 Project is a large highway construction project being directed by the Colorado Department of Transportation (CDOT) and is located along the Interstate 70 (I-70) corridor through the Denver Metro Area (Figure 1). The project consists of reconstructing a 10-mile section of I-70 east of downtown Denver, complete reconstruction of I-70 from Brighton Boulevard to I-270, including adding one express lane in each direction, removing the 53-year-old viaduct and lowering the interstate between Brighton Boulevard and Colorado Boulevard, constructing a 4-acre cover park over a portion of the lowered interstate, and widening I-70 from I-270 to Chambers Road, to add one express lane in each direction. The project extends from I-25 on the west to Chambers Road on the east side of the project area (see Figure 1).

1.2 BACKGROUND AND SITE HISTORY

A portion of the Central 70 Project will require multiple private property acquisitions, which consist of current and former commercial and industrial properties. Several of these properties have historical soil and groundwater contamination from a wide range of contaminant types (e.g., heavy metals, solvents, petroleum). There are two EPA Superfund sites and one proposed Superfund site including: 1) Asarco Globe Plant, an 89-acre facility located at East 51st Avenue and Washington Street (chemicals of concern include cadmium, arsenic, lead, and zinc), 2) Chemical Sales Company, a five-square-mile site located at 4661 Monaco Street (chemicals of concern include chlorinated solvents), and 3) Vasquez Boulevard & Interstate 70, a former smelting plant (contaminants of concern include heavy metals).

CDOT's consultant (Pinyon Environmental, Inc.) conducted a series of environmental investigations as part of the preparatory work for the Central 70 Project. The subsurface investigation report, prepared by Pinyon Environmental, Inc. (October 2016), *Limited Subsurface and Groundwater Investigation Report*, documented various types of contaminants at several parcels in the proposed project area.

The *Limited Subsurface and Groundwater Investigation Report* identifies the following known properties in the project area with a higher risk of encountering soil and/or groundwater contamination. The sites are identified as follows:

- Parcel AP-52, 4631 Josephine Street, Denver, CO
- Parcel AP-55, 4600 Josephine Street, Denver, CO
- Parcel AP-86 and AP-86B, 4640 Steele Street, Denver CO
- Parcel AP-88, 3501 E. 46th Avenue, Denver, CO
- Parcel AP-91 and AP-93A, 3558 E. 46th Avenue, Denver, CO
- Parcel AP-94, 3601 E. 46th Avenue, Denver, CO

Specific details regarding the previous investigation results are included in Appendix A of the Limited Subsurface and Groundwater Investigation Report.

As part of the bid phase of the project, KMP reviewed the Phase I and Phase II environmental assessments provided by CDOT for many of the right-of-way (ROW) parcels associated with the Central 70 project. Additionally, KMP reviewed publicly available documents for these parcels from the CDPHE and Colorado Department of Labor and Employment (CDLE) Oil and Public Safety (OPS) Division for files relating to environmental concerns. Additionally, KMP conducted field reconnaissance, observing from the public ROW, of property conditions specifically relating to hazardous building materials and environmental conditions. Aerial photographs of the ROW parcels to be acquired as part of the project were reviewed. Based on the findings, KMP identified approximately 50 parcels that may have been adversely affected by historical activities. Additional limited willow subsurface investigation was recommended of these parcels to further assess site

ED_002842A_00000589-00242

soil quality within the unsaturated zone. Supplemental geotechnical drilling was conducted during the winter and spring of 2018 throughout the project area including excavation of a test pit for soil sampling. The geotechnical drilling activities and test pit excavation activity were covered in the health and safety plan developed for the Geotechnical and Early Work phase of the project under a separate submittal.

The construction activity will require lowering of Interstate 70 between Brighton Boulevard and Colorado Boulevard. Excavation of soil will be required in both the existing Interstate 70 ROW, as well as the newly acquired ROW properties. To efficiently excavate large amounts of soil from the lowered roadway section (existing Interstate 70 ROW), thereby reducing soil handling, construction delays, and disturbance to the surrounding areas (e.g. noise, dust, exhaust, time to complete activity), and to ensure compliant materials management, KMP is conducting environmental soil sampling, to laterally and vertically characterize soil quality in the lowered section, before excavation activities begin for the construction phase of the project.

Additionally, numerous acquired ROW parcels have been improved with buildings that are slated for demolition as part of the construction activities. For demolition projects, both State and EPA Regulations require inspections for asbestos. Under the Colorado Department of Public Health and Environment (CDPHE), Regulation 8, buildings of any age may contain asbestos and the building must be inspected for asbestos by a State Certified Building Inspector. Based on the age of the buildings, there is a possibility that asbestos containing materials (ACM) and lead based paint (LBP) exist within building materials. Before demolition of the buildings, hazardous building materials assessments will be conducted by State of Colorado Certified Inspectors.

Prior to any of these activities occurring, potholing activities will take place to identify utilities in the area. Potholing activities consist of utilizing a high-pressure stream of water to break up the ground surface and a vacuum truck to remove the soil and water from the hole to expose any utilities in the area of anticipated excavation or borings. This HASP also covers the operations and maintenance of existing infrastructure within the O&M limits during construction including the I-70 Mainline and associated infrastructure, local agency infrastructure, drainage, water quality, ITS and electronic toll collection facilities, utility services, traffic signals and lighting, railway structures, fencing, snow and ice control services. The O&M of I-70 within the limits defined by Schedule 11 of the PA for the Operating Period, includes providing resources to safely maintain the roadway throughout the Operating Period and to meet handback requirements for asset preservation including repair and renewal; courtesy patrols; and incident response.

1.2.1 CHEMICALS OF CONCERN

Due to scale and nature of the Central 70 Project, there are numerous and varying chemicals of concern (COCs), depending on the specific location of the proposed work activities. Contaminants that could be encountered include, but are not limited to, petroleum hydrocarbons, chemical solvents, heavy metals, ACM, LBP, and polychlorinated biphenyls (PCBs).

The Limited Subsurface and Groundwater Investigation Report (Pinyon 2016) summarizes information obtained during the soil and groundwater investigations, conducted on behalf of CDOT, previously completed in preparation for this project:

- Polycyclic aromatic hydrocarbons (PAHs), including benzo(a)pyrene, were detected in soil samples at concentrations exceeding the USEPA Regional Screening Levels (RSLs) in multiple soil samples collected from project areas.
- Evidence of historical landfilling, including potentially explosive levels of landfill gases and ACM, both friable and non-friable, were detected near the Denver Coliseum.

ED_002842A_00000589-00243

- Various structures on the C-70 ROW are known to contain lead paint where workers will need to follow OSHA Lead in Construction Standard under 29 CFR 1926.62 when performing demolition of sign poles, bridge rail and other structures with lead paint. See Appendix J for Management of structures with lead and heavy metal paint.
- Arsenic was detected at concentrations exceeding the USEPA RSLs for residential land use throughout the project area; however, the concentrations were generally below the CDPHE background value for naturally occurring arsenic in Colorado.
- Lead was detected in soil throughout the project area at concentrations that exceeded USEPA RSLs.
- Gasoline range organics (GRO), diesel range organics (DRO), and oil range organics (ORO) have been documented in soil at numerous locations within the project area.
- Cadmium, arsenic, manganese, iron, chloroform, and hexavalent chromium were detected in groundwater above the CDPHE Regulation No. 41, The Basic Standards for Groundwater, 5 Colorado Code of Regulations (CCR) 1002-41 ('CDPHE groundwater standards') throughout the project area.
- Volatile organic compounds (VOCs), including tetrachloroethene and trichloroethene, and semi-volatile organic compounds (SVOCs), were detected in groundwater above the CDPHE groundwater standards throughout the project area.

Based on the previous investigation activities and readily available information pertaining to the Superfund sites, various contaminants including PAHs, landfill gases, ACM, metals, VOCs, and SVOCs are present in the subsurface of the project area. Additionally, hazardous building materials such as ACM and LBP, may be present in existing buildings that are slated for demolition within the project area.

1.2.2 COMPLIANCE REQUIREMENTS

This HASP will be distributed to the Department, all KMP and KIC project personnel, and subcontractors. All KMP and KIC project personnel and subcontractors performing field activities will be subject to the standards, procedures, and requirements specified in this HASP, which will be available on-site at the project office, and will be required to certify their review and intended compliance with the document before conducting any activities. Additionally, all personnel will be responsible for compliance with the health and safety requirements of KMP and KIC. Site personnel involved in soil disturbing activities within the boundary of a recognized EPA designated Superfund site where cleanup activities have been completed will be required to have 24-hour HAZWOPER training under 29 CFR 1926.65. If during excavation or subsurface disturbance activities, contaminated material is encountered, then field personnel who have completed the OSHA 40-hour HAZWOPER training including the site monitoring technicians (MTs) and Health and Safety Officer (HSO) will be brought in to assess the environmental conditions and determine a plan forward. All field personnel will be briefed by the HSO of chemical hazards associated with site contaminants during scheduled HASP training sessions. Field personnel are expected to comply with all sections of the Site HASP. Furthermore, field personnel will also follow their respective company Corporate Health and Safety Program for their specific work task(s) for compliance with OSHA regulations. All contractors working on the Central 70 Project site and under KMP and KIC's direct supervision must comply with the site HASP and at a minimum, are required to become familiar with the following sections of the plan:

- Background, Site History, Contaminants of Concern – Section 1
- Planned Activities – Section 3
- Job Hazard Analysis – Section 4
- Personal Protective Equipment – Section 5

ED_002842A_00000589-00244

- First Aid and Safety Equipment – Section 6
- Air Monitoring – Section 7
- Site Controls – Section 8
- Emergency Procedures - Section 9
- Accident and Injury Reporting – Section 10
- Utility Location and Protection Procedures - Appendix A
- Field Standard Operating Procedures (SOPs) - Appendix B
- Heat and Cold Stress Monitoring and Prevention - Appendix C
- Job Hazard Analysis – Appendix D
- Route to the Hospitals – Appendix F

This HASP may be modified if it becomes evident that the provisions specified are not feasible or adequate to protect the health and safety of personnel, or if supplemental activities are implemented that are not addressed herein. All changes to this HASP will be documented in the record of revisions table at the beginning of this document, as well as by providing "track changes" versions in Aconex. Changes should be reviewed by the KMP Environmental Manager, HSO, MTs, and Field Personnel before implementation onsite. As changes are made to the HASP, KMP must relate all changes and explain how they may change potential exposure hazards to all subcontractor supervisors. A copy of the most current HASP will be available to all project personnel at all times via Aconex (the project document control system). The HSO or their designee will be responsible for informing KMP and KIC representatives and field supervisors of changes made to the HASP that may affect work practices associated with site contaminants. The notifications may be performed during the daily Job Hazard Analysis (JHA) briefings, during additional HASP training updates, or other means deemed effective in communicating changes to the site HASP. Field supervisors are responsible to ensure that their work crew is made aware of these changes.

2 Organization Structure

This HASP is organized to ensure that information regarding changes in site conditions, potential exposure to hazards, and worker safety flows freely within the project team. Additionally, OSHA requires that a chain of command with lines of authority, responsibility, and communication is established for each project with a HASP. Therefore, a chain of command is established that ensures that all site operations will be conducted safely.

KMP is the developer responsible for the satisfactory implementation of the construction of the Project. KIC is the primary construction contractor responsible for overall construction the Project. In this capacity, KMP will oversee and monitor the work and KIC will construct the Project, although other subcontractors will be responsible for conducting their work in a safe manner and, if necessary, assume the role of incident commander. Table 2.1 provides the contact information for key technical project personnel; their responsibilities are described below.

Table 2.1 Project Personnel Contact Information

Responsibility	Name	Organization	Phone Number	Email
CDOT Environmental Project Manager	Tim Buntrock	CDOT	(303) 404-7043	Timothy.buntrock@state.co.us
CDOT Recognized Hazardous Materials Manager	Scott Epstein	Pinyon Environmental	(720) 536-4189	epstein@pinyon-env.com

ED_002842A_00000589-00245

KMP Environmental Project Manager	Megan Wood	Kiewit Infrastructure	(970) 819-8147	megan.wood1@kiewit.com
KMP Site Health and Safety Officer	Ron Crandall	Foothills Environmental	(720) 254-0279	ron@foothillsusa.com
KMP Technical Manager	Del Walker	KMP	(303) 859-3424	Del.Walker@kiewit.com
KIC Construction Manager	Pete Remington	KIC	(303) 981-2236	Peter.remington@kiewit.com
BRMMP Compliance Manager	Laura Tobin	WSP	(303) 726-8100	Laura.Tobin@wsp.com

2.1.1 PROJECT AND TASK MANAGERS

The Environmental Manager for KMP is Megan Wood. Depending on whether construction phase, trenching and excavation, caisson drilling, potholing activities, soil sampling, or hazardous building materials sampling task is being conducted, the appropriate person identified in Table 2.1 will serve as the Task Manager.

The Task Managers will assist the KMP Environmental Manager with:

- Assigning and procuring resources (personnel, equipment, subcontractors) to the project
- ensuring adherence to the HASP
- maintaining communication with the client
- maintaining communication with the CDPHE, CDOT, and other state and local agencies
- managing project schedule and budget
- ensuring compliance with all KMP and project-specific programs and protocols
- managing the document control process
- preparation of technical reports and other project documents
- monitoring the quality of the technical and management aspects of the project
- managing field teams

2.1.2 SITE HEALTH AND SAFETY COORDINATOR

The KMP Site Health and Safety Officer (HSO) is Ron Crandall. Mr. Crandall is a Certified Industrial Hygienist, and meets the Schedule 17, Section 23.21.2 requirements of the Project Agreement. The HSO may designate specific health and safety responsibilities as deemed necessary to a specific task manager or MT. In the absence of the HSO during field activities, the task manager or MT will perform the responsibilities of the HSO. The assignment will continue until the end of the field task or until the Project Manager re-assigns the responsibilities. The HSO or the HSO's designee will be responsible for:

- observing field activities for compliance with this HASP
- ensuring that decontamination procedures are followed and are effective
- ensure the site documentation of KMP employees' medical clearances and emergency medical treatment programs is maintained
- ensure that 29 CFR 1926 is complied with by KMP contractors during the construction of the project.

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The HSO or HSO's designee will be onsite or readily available by radio, telephone or pager during site work. The HSO or HSO's designee will conduct periodic site inspections to document whether KMP and KIC personnel and their subcontractors are complying with all requirements of this HASP and all KMP safety policies. Additionally, the HSO or HSO's designee will assist in onsite emergencies, if any, and modify the health and safety protocols or terminate field work when unsafe work conditions exist. Task managers will ensure that site personnel are trained in health and safety protocols and will observe that field personnel wear appropriate PPE. Data from direct-reading instruments, hazards evaluation, and any occurrence of site injury or illness will be recorded by the HSO, Task Manager, or Monitoring Technician.

The HSO or HSO's designee will periodically monitor and/or be notified by the respective KMP or KIC Superintendents, MT, or Contractor's supervisors of unsafe conditions or work behaviors. Where non-compliance with the Site HASP and/or the KMP or KIC safety program is encountered, corrective measures will be implemented including employee removal from the work site. Behaviors such as, but not limited to:

- horse play
- fatigue
- evidence of lack of fitness for duty
- heat or cold stress
- irresponsible behavior
- harassment (physical or verbal threats/abuse) of KMP or other site workers

If unsafe conditions are encountered, if illness or injury occurs, or if the level of protection needs to be changed, the HSO will be notified and will consult in a timely manner with the Environmental Manager, as well as other authorized individuals. If the HSO, or any individuals on site observe unsafe work practices they will take immediate action to address the unsafe work practice and implement corrective measures including notifying the HSO and Environmental Manager.

In the event that unsafe acts conducted by KMP or KIC contractors are observed, the HSO or HSO's designee will inform the contractor and ensure that the subcontractor complies with this HASP. If the subcontractor continues with unsafe practices, the HSO or HSO's designee will have the authority to stop work until corrective measures are implemented. Subcontractors are responsible for correcting any unsafe conditions created by their activities or acts by their employees in compliance with the HASP and in compliance with applicable OSHA standards and Federal, State and local regulations.

The HSO in conjunction with the KMP Environmental Manager will determine if work practices or site conditions require changes to this HASP including, but not limited to, upgrades or downgrades in personal protective equipment; changes in equipment or methods to more safely accomplish work tasks or monitoring; and implementation of additional engineering or administrative controls. The HSO will notify the Environmental Manager of these changes.

During the course of site work, each KMP and KIC subcontractor must ensure that their respective field team members are properly trained to fulfill their assigned work tasks in accordance with all OSHA regulations under 29 CFR 1926 (Construction). The HSO will provide the required site HASP training to KMP and KIC contractor personnel during the scheduled training sessions. The HSO will be responsible for the onsite implementation of the accident, incident, and near hit investigation process (Section 10). They will work with the Environmental Manager, Field Team, and contractor personnel as necessary to gather information necessary to determine the cause of the accident, incident, or near hit; to determine the corrective actions necessary to prevent repeating the accident, incident, or near hit; and to conduct the investigation and track it through to the implementation of a corrective action.

The HSO will be equipped with the following:

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1. Communication equipment and a vehicle.
2. Monitoring and detection equipment for flammable gas, oxygen sufficiency, toxic gas, and other hazards as applicable.
3. Depth gauging equipment, sampling equipment and sampling containers.
4. Personal protective equipment (PPE), when required. PPE must be selected which will provide protection from the specific hazards which are likely to be encountered during work on the project.

The HSO will recommend and supervise those actions which will minimize the risk of Hazardous Substance related injury to the workers, Department personnel, the general public, property and the environment. The HSO will prepare a site-wide written procedure for the monitoring of permit required confined space entry including requirements for air monitoring the confined space with a combustible gas indicator (CGI) for percent (%) O2, %LEL, H2S, CO and a photoionization detector (PID) to monitor for VOCs. The host employer will provide written confined space entry procedures for their work in accordance with the site wide confined space entry program. The host employer will notify the HSO, KIC Safety Manager, and Environmental Manager 48 hours in advance of any permit required confined space entry, storage tank removal, drilling, excavation, trenching, or dewatering operations. The written confined space entry plan will identify authorized entrants, attendants, and rescue personnel roles and responsibilities in accordance with OSHA 29 CFR 1910.146. When working in areas of known contamination or when there is a potential to encounter an atmospheric hazard, a site monitoring technician will perform air monitoring representative of the workers breathing zone and pre-entry and continuous air monitoring during confined space entry using a Combustible Gas Indicator (CGI) for % oxygen, LEL, H_2S, CO and PID for VOCs.

Confined spaces may include but are not limited to trenches, and drill holes associated with this project. The HSO will ensure that all hazardous substance and solid waste related testing, sampling, monitoring and handling for this project to ensure compliance with applicable statutes. The HSO will submit a daily diary to KMP to include dates and times on site, equipment used, and field monitoring results, visual observations, conversations and directives given. For confined space entry, the entry employer shall submit their written confined space entry plan to the HSO for review prior to any planned entry. .

2.1.3 MONITORING TECHNICIAN (MT)

Monitoring technicians are responsible for monitoring of hazardous substances during work on the project. The MT will be experienced in the operation of monitoring devices, identifying substances based on experience and observation, and field sampling (for testing) of all media that may be found on the site.

The MT will be equipped with the following:

1. Communication equipment and a vehicle.
2. Monitoring and detection equipment for flammable gas, oxygen sufficiency, toxic gas, and other hazards as applicable.
3. Personal protective equipment, when required. PPE will be selected which will provide protection from the specific hazards which are likely to be encountered during work on the project.

The MT will be present on site and perform monitoring when work is being performed in areas of known or suspected Hazardous Substances.

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The MT will monitor for compliance with regulations, the project HASP, the Materials Management Plan, and the environmental documents of the project. The MT will immediately notify the KMP Environmental Manager and HSO of any hazardous conditions.

2.1.4 FIELD TEAM

The Field Team is responsible for compliance with OSHA regulations under 29 CFR 1926 and safely implementing the tasks described herein, which includes trenching and excavations for utility and interstate reconstruction, caisson and subsurface drilling and performing bridge and highway construction tasks. The HSO, MT and Environmental Manager will provide direction for decontamination of field equipment and PPE where subsurface soil and groundwater contamination may be encountered. All activities conducted onsite will conform to KMP and KIC SOPs and this HASP. Field personnel will report all safety concerns, task-related problems and successes, and monitoring equipment deficiencies/malfunctions directly to the HSO. The Field Team will assist the HSO with the accident, incident, and near hit investigation process.

This HASP does not cover routine construction safety, nor does it cover employee contact with, or use of, chemicals brought on-site by employees or contractors. Compliance with OSHA regulations including general safety practices will be followed during all phases of work on this project. Procedures to ensure employee safety during these activities are the responsibility of the individual contractors working on this site and each contractor will refer to its company's health and safety program for compliance with routine construction safety procedures

3 Description of Planned Activities

This section identifies the type of planned construction and demolition activities that will be performed during the project. Central 70 Site construction activities will include:

- Complete reconstruction of I-70 between Brighton Boulevard to I-270
- Widening of the interstate from I-270 to Chambers Road
- Demolition of existing viaduct and bridge structures
- Trenching and excavation for underground utility replacement
- Potholing for utility locates
- Subsurface excavations for lowering the interstate between Brighton and Colorado Boulevard
- construction of a 4-acre covered park over a portion of the lowered interstate
- Caisson and subsurface drilling for installation of utilities, bridge and interstate structures
- Hazardous building materials sampling

These field tasks are described briefly below; Section 4 identifies the associated hazards and protective measures to be implemented.

3.1 CENTRAL 70 RECONSTRUCTION WORK

KMP will oversee the reconstruction of I-70 between Brighton Boulevard to I-270 and lane widening from I-270 to Chambers road. A portion of the project will require lowering of Interstate 70 between Brighton Boulevard and Colorado Boulevard. Excavation of soil will be required in both the existing Interstate 70 ROW, as well as the newly acquired ROW properties in the lowered section of the reconstruction area. For reconstruction of the Central 70 highway between Brighton Boulevard and I-270, significant subsurface excavation, trenching and caisson and other drilling

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activities will be required for replacement of underground utilities and construction of the lowered interstate.

Several of the commercial and industrial properties within the ROW where subsurface excavations and drilling work will occur have historical soil and groundwater contamination from a wide range of contaminants including heavy metals, petroleum and other contaminants. Furthermore, a portion of the reconstruction project located west of Colorado Boulevard will require subsurface work within the boundaries of the Vasquez Boulevard and I-70 (VB/I70) Superfund site and the Asarco Globe Plant site. Although the two commercial/industrial sites and most of the residential areas within the boundary of the VB/I70 Superfund site have been cleaned up per the requirements of the EPA Record of Decision (ROD), the EPA was not able to gain access for some of the residential property owners located in Operable Unit 1 (OU1). Furthermore, southern portion of OU3 for the Asarco Globe Plant site crosses the Central 70 ROW. Therefore, some of the subsurface work activities may occur in areas where there is a potential to encounter soil and ground water contamination from other commercial and industrial sites in the area.

During the Geotechnical and Early Work phase of the project, KMP conducted environmental soil sampling to laterally and vertically characterize soil quality for the existing CDOT Interstate 70 ROW areas where soil will be disturbed. Grid based soil sampling was performed by KMP including collection of soil samples at regularly spaced intervals for laboratory analysis for potential COCs and to identify intended soil re-use or disposal purposes as necessary. The purpose of the sampling was to ensure that soil has been adequately characterized prior to the planned subsurface excavation activities and to characterize it for reuse and disposal decisions and compliant materials management.

KIC and subcontractors performing soil excavation and disturbance activities in areas identified with known or suspected soil and/or groundwater contamination will use a MT to monitor the work area and manage the soil in compliance with the site materials management plan. KMP will use the sampling results to prepare a soil excavation plan that will map out discreet excavation volumes, and how the soil will be either be re-used or disposed of offsite.

Prior to subsurface trenching and excavation or drilling activities, KIC and subcontractor personnel will follow the requirements of KMP and KIC's Utility Location and Protection Procedures (Appendix A). KMP and KIC will subcontract with both public and private utility locators to mark the location of potential subsurface utilities near the proposed trenching, excavation and drilling locations.

For trenching and excavation or subsurface drilling activities in areas of known or suspected soil and groundwater contamination, MTs will be used to screen for VOCs using a photoionization detector (PID) with a 10.6 electron volt (eV) lamp from the ground surface to the breathing zone of each trench, excavation or drilling location. The MTs will also be equipped with an aerosol dust monitor during soil disturbance and trenching and excavations activities to monitor airborne dust levels and ensure dust suppression controls are in place in order to comply with Federal, State and local regulations and the site action levels specified in Table 7.1 and Table 7.2 of this HASP. The MT will also be certified to visually inspect the excavation areas for evidence of ACM. If suspected ACM is encountered, the MT will collect samples of the suspect material and submit to the laboratory for analysis. No excavation will proceed until a determination is made if the materials are ACM. If ACM is encountered, the MT will immediately notify the construction manager, HSO and Environmental Manager. No excavation work will proceed until proper controls are in place in accordance with CDOT, City and County of Denver and CDPHE asbestos in soils regulations. The MT will be fully trained in compliance with this HASP, with CDOT environmental, health and safety management specifications and with OSHA HAZWOPER regulations under 29 CFR 1926.65 and 29 CFR 1910.120.

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If during trenching and excavation or subsurface drilling activities soil and/or groundwater contamination is encountered, the MT will notify the HSO, the Environmental Project Manager and KMP and KIC site supervisors. The MT will use a field notebook to log the PID readings for VOCs in the work area and include additional readings for benzene, LEL, O2, H2S and dust levels. Additional information will be recorded for sample locations, time the measurements were taken and a site sketch showing the locations of any elevated direct reading measurements. Representative soil samples will be collected and sealed in a new plastic bag and allowed to equilibrate for PID headspace analysis. The results of the headspace analysis and the lithologic description will be recorded in the field notebook. For composite sampling, volumes of material from several of the selected sampling intervals are physically combined and mixed to form a single homogeneous sample, which is then analyzed.

The onsite MT will also be certified per the CDPHE regulations to identify ACM in soil. The MT will notify the CM, HSO and the Environmental Manager, if suspected ACM is present in soil. Any additional soil disturbance and sampling will follow CDOT's Regulated Asbestos-Contaminated Soil Management Operating Procedure, in accordance with CDPHE Hazardous Materials and Waste Management Division Regulations, Section 5 (CDOT 2016). Additional samples would be collected by a CABI for ACM analysis by a certified environmental laboratory, in the event suspect ACM is identified. Field and laboratory quality assurance/quality control (QA/QC) is discussed in Section 6. All soil samples will be investigated using a standard 5 to 10 business day turnaround time. A rush turn-around time may be obtained with advance approval from the Environmental Manager.

Soil sample locations will be recorded in the field logbook as sampling is completed. A picture of the sample location will be saved to the electronic monitoring technician form. Each sample location will be flagged, and its GPS location will be recorded with a handheld GPS unit. Investigation derived waste soil will be placed into an appropriate container, labeled, and moved to an offsite staging area, for waste characterization sampling and disposal determination.

KIC and its subcontractors will follow the procedures outlined in this HASP and their corporate standard operating procedures while using heavy construction and excavation equipment for safely performing their work tasks in compliance with OSHA regulations for this project. Each contractor will provide their respective employees Hazard Communication training per OSHA 29 CFR 1926.59 and additional training for specific work tasks in accordance with OSHA 29 CFR 1926 (Construction Industry) regulations, specifically respirable crystalline silica (29 CFR 1926.1153) where airborne dust levels potentially exceed OSHA PEL and action level.

3.2 DEMOLITION OF EXISTING VIADUCT AND BRIDGE STRUCTURES

A portion of the project will require removal of the existing viaduct and additional bridge and road structures as part of the lowering of Interstate 70 between Brighton Boulevard and Colorado Boulevard. Demolition of existing bridge and highway structures will be required in both the existing Interstate 70 ROW, as well as the newly acquired ROW properties. The HSO will review the Bridge Removal Plan for compliance with OSHA regulations when a draft plan is prepared by KIC. Contractors will follow the procedures outlined in this HASP and their corporate standard operating procedures while using heavy equipment for safely performing their work tasks in compliance with OSHA regulations for this project.

Demolition of existing bridge structures may also include bridge structural components coated with lead and heavy metal paint. Contractors performing removal of structures containing lead paint shall follow the SOP for management of structures containing lead and heavy metals and implement a written lead compliance program for their employees. In addition, some bridge and roadway components may have asbestos containing materials (ACM). Any existing bridge or highway structures identified by CDOT, KMP or KIC as having lead and heavy metal paint or ACM

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will be handled in accordance with all federal, state and local regulations. This may include abatement of asbestos or lead and heavy metal paint by certified workers prior to demolition. For structural components that contain LBP, heavy metal-based paint and/or ACM that remain in place during demolition, the contractor performing the bridge removal work will develop a materials management plan and site-specific health and safety procedures for protection of the workers, the public and the environment.

For removal of bridge and highway components that have LBP, heavy metals, ACM or other contamination, the employer performing the work will provide an exposure assessment for its employees per OSHA regulations for employees that are potentially exposed above permissible exposure limits (PELs) or action levels. Potential contaminants of concern (PCOC) associated with existing bridge and highway structures include asbestos, lead and heavy metals, respirable silica or other chemicals of concern. The contractor will also use a MT to monitor the dust levels and air quality in the work area. Depending on the demolition methods used and the contaminants of concern, the employer will perform an exposure assessment for PCOCs including asbestos, lead and other heavy metals, respirable silica and other heavy metals found in painted bridge structures in accordance with OSHA regulations including Asbestos regulation (29 CFR 1926.1101), Lead in Construction (29 CFR 1926.62), Respirable Crystalline silica (29 CFR 1926.1153) and other heavy metals in accordance with 29 CFR 1926.

KIC and each subcontractor working on bridge and highway demolition will provide their respective employees Hazard Communication training per OSHA 29 CFR 1926.59 and additional training for specific work tasks in accordance with OSHA 29 CFR 1926 (Construction Industry) regulations

3.3 HAZARDOUS BUILDING MATERIAL SAMPLING

Specific KMP and KIC contractors have conducted or are in the process of conducting a hazardous building materials assessment of existing buildings that are slated for demolition as part of the construction activities. Based on the age of the buildings, there is a possibility that ACM and LBP exist within building materials. Before demolition of the buildings, a hazardous building materials assessment will be conducted. During the assessment, asbestos and lead based paint surveys of the buildings will be conducted by a Certified Asbestos Building Inspector (CABI) and a CDPHE certified lead inspector. The objective of the survey is to identify specific locations, quantities, and conditions of ACM and LBP throughout the buildings. A demolition permit will be obtained from the CDPHE for each building or structure slated for demolition.

The survey will consist of the visual inspection and quantification of all suspect ACM and LBP throughout all portions of the buildings, and the collection and analysis of representative samples of each suspect material. Samples will be collected from suspect materials as identified by the CABI and lead inspector. Each type of suspect ACM and LBP will be noted and quantified, its accessibility and condition will be evaluated, and the amount of damage will be estimated.

3.4 ABATEMENT OF HAZARDOUS BUILDING MATERIALS

Specific KMP and KIC contractors have are in the process of conducting hazardous building material abatement for asbestos and lead-based paint for existing buildings that are slated for demolition as part of the construction activities. Based on the age of the buildings, there is a possibility that ACM and LBP exist within building materials. Before demolition of the buildings, a hazardous building materials assessment will be conducted, and friable asbestos is required to be abated prior to demolition. Only certified asbestos abatement contractors and certified employees will conduct abatement activities. Contractor personnel will perform abatement activities in accordance with CDPHE Regulation No. 8 and EPA NESHAP regulations. If any lead

ED_002842A_00000589-00252

abatement is required, only certified workers will perform abatement activities in accordance with CDPHE Regulation No. 19.

The employer performing abatement work will provide an exposure assessment for its employees per OSHA regulations for employees that are potentially exposed above permissible exposure limits (PELs) or action levels for asbestos, lead paint and other PCOC in accordance with OSHA regulations including Asbestos (29 CFR 1926.1101), Lead in Construction (29 CFR 1926.62), and other PCOC in accordance with 29 CFR 1926 (Construction Industry) regulations. Each contractor will provide their respective employees Hazard Communication training per OSHA 29 CFR 1926.59.

4 Job Hazard Analysis

A JHA will be conducted for each task described herein (Appendix D). Hazards associated with Site investigation may include, but are not limited to, chemical exposure, physical hazards, and environmental hazards. Hazards will be controlled using the following hierarchy:

- Elimination: physically remove the hazard
- Substitution: replace the hazard
- Engineering controls: isolate people from the hazard
- Administrative controls: change the way people work
- PPE: protect the worker with PPE

Heavy equipment and machinery will be required during reconstruction activities. Potential hazards associated with these activities include physical contact with heavy equipment and machinery; electrical hazards with installation equipment; slips, trips, and falls; dermal contact with contaminated soils, groundwater; and inhalation of VOCs.

Although KMP and KIC employees will oversee some of the reconstruction activities performed by a subcontractor, KMP and KIC employees need to be aware of the specific hazards that may be present onsite. The subcontractor is responsible for conducting reconstruction activities in a safe manner, consistent with OSHA requirements, and in compliance with this HASP. KMP and KIC employees should be aware of the following hazards:

- Vehicle and construction traffic
- Heavy equipment operation
- Trips, slips, and falls
- High noise levels from heavy equipment
- Exposure to contaminated soil, groundwater, or vapors
- Particulate/dust from construction, demolition, excavation and drilling operations
- Wire rope “whip” hazards during drill rig use
- Any unguarded equipment, including gears, belts, and spinning augers
- Any rotating equipment (keep loose clothing or other items away from rotating items)
- Hoisting hazards
- Proper leveling of the heavy equipment
- Transport vehicles
- Starting the drill rig motor when the drill pipe is not secure
- Subcontractor applying too much down-pressure on the auger or drill rig having the machine topple over or bit shatter
- Drill rig contact with overhead/underground electric power lines

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- Serious burns can occur if workers are not careful and touch the hot exhaust mufflers of the equipment engines
- Open hole collapse
- Landfill gas hazards during drilling (e.g., methane)

Procedures to be implemented to reduce the hazards during reconstruction activities will include the use of PPE, traffic control and flagging, and monitoring practices such as air monitoring. Underground utility locations will be marked prior to the start of any intrusive activities, and drill rigs and excavation equipment will be kept a minimum of 6 feet away from underground utilities and 10 feet away from overhead power lines. All activities near overhead power lines will be conducted with equipment capable of operating safely with small overhead working distance.

The purpose of air quality monitoring is to identify airborne contaminants, to verify and determine the level of worker protection needed, and for protection of downwind receptors. Air monitoring will be conducted by a MT using a combustible gas meter (CGI) with a PID equipped with a 10.6 electron volt (eV) lamp. The 5-gas meter or equivalent device will be used to monitor for percent lower explosive limit (%LEL), % oxygen (%O2), carbon monoxide (CO) and hydrogen sulfide (H2S). During site trenching, drilling and excavation activities, the breathing zone of workers closest to the possible source of dust or VOC emissions and the downwind safety barrier will be monitored for the presence of VOCs.

The subcontractor is responsible for providing barrier tape and the placement of danger signs for intrusive work in high traffic areas. Barrier tape will be provided around excavations and any other heavy equipment to restrict pedestrian traffic from a minimum area of 10 feet beyond the point of work. KMP and KIC employees must survey the work area thoroughly and select an observation point that provides adequate clearance from potential hazards.

4.1 CHEMICAL HAZARDS

The primary COCs that could be encountered during the site construction activities include but are not limited to:

- Chemical and metal constituents in soil:
  - Benzene, toluene, ethylbenzene, xylenes, and other volatile petroleum hydrocarbons
  - Benzo(a)pyrene and other polycyclic aromatic hydrocarbons
  - Arsenic, lead, cadmium, hexavalent chromium, and other heavy metals
  - Perchloroethylene (PCE), Trichloroethylene (TCE), 1,2-dichloroethene, vinyl chloride (VC), chloroform and other chlorinated compounds
- Asbestos-containing materials in soil and/or building materials
- Lead based paint in building materials
- Lead and heavy metal-based paint in existing bridge, sign posts, and other roadway structures
- Respirable crystalline silica in soil, in existing concrete structures and new building materials
- Methane, H2S and other landfill gases
- Chemicals brought on site by the Developer or subcontractors

The Developer will maintain on-site industrial hygiene information for products and materials used on site including safety data sheets (SDS) and worker “right to know” information.

Additional information regarding chemical hazards are provided in the NIOSH Pocket Guide to Chemical Hazards datasheets for the primary COCs, which are presented in Appendix E.

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Soils, groundwater, and bedrock cores generated during the trenching, excavation and drilling activities described herein may pose absorption, inhalation, or ingestion hazards to these chemicals for field personnel. Handling of equipment that has been exposed to contaminated media, as well as decontamination fluid generated from the cleaning of equipment, may pose an absorption, inhalation, and/or ingestion risk. In addition, sample preservatives (e.g., hydrochloric and nitric acids) may pose absorption, inhalation, or ingestion hazards for field personnel handling preserved sample containers, and coolers/boxes holding sample containers. Potential chemical exposures are anticipated to be through inhalation of volatile COCs, inhalation of particulates containing COCs, inhalation of respirable crystalline silica from dust and destructive demolition activities, nuisance dust, and direct contact with soil or groundwater containing the COCs. Engineering controls will be established to minimize these exposures when required. Direct contact exposures will be reduced by strict adherence to established work zones, including exclusion zones, contaminant reduction zones, and support zones. Potential exposures will be reduced by establishing and implementing health and safety procedures, including use of PPE, respiratory equipment and personnel and equipment decontamination.

There may be work areas near or around historical landfills where explosive gases (e.g., methane) are a concern. Methane is the landfill gas with the potential for buildup of explosive levels; however, other flammable gases may be present including ammonia, hydrogen sulfide, non-methane organic compounds (NMOCs).

4.1.1 HAZARD CONTROLS

To prevent exposure to chemical hazards, KMP and KIC safety rules and personal hygiene procedures will be followed. Proper PPE will be donned and decontaminated in accordance with SOPs (Appendix B), including the use of disposable nitrile gloves during sample collection to prevent exposure to contaminated media. Air monitoring will be performed in accordance with Section 7 of this HASP.

Safe work practices, including restriction of eating, drinking, or smoking (not within 50 feet of excavation) to certain times and places will be enforced during excavation activities at the Site.

4.1.2 CHEMICAL AND METAL CONSTITUENTS

Field personnel will minimize potential chemical hazards by: (1) avoiding direct contact with soil and groundwater, (2) performing air monitoring to determine the necessary level of personal protective equipment to avoid inhalation exposures, (3) avoiding generation of and ingestion or inhalation of dust and/or aerosolized water, and (4) conducting air monitoring for explosive hazards when trenching, excavation or drilling near historical landfills.

4.1.3 ASBESTOS CONTAINING MATERIAL

Soil and building materials at this Site may contain ACM. Asbestos is the generic name for six naturally occurring minerals that have been used in commercial products for their strength, flexibility, low electrical conductivity, and resistance to heat and chemicals. The most common fibers include (but are not necessarily limited to) chrysotile, amosite, and crocidolite. When ACM is disturbed, fibers can be released into the atmosphere. Because of their size and needle-like shape, asbestos fibers can penetrate body tissues and remain imbedded. Significant exposure to asbestos fibers can result in various respiratory diseases including asbestosis, mesothelioma (cancer of the chest lining), and other cancers of the respiratory and digestive system. KMP and KIC and subcontractor personnel who will be involved with soil disturbing activities will have had 2-hour asbestos awareness training. Each trainee is issued a certificate of completion and a

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sticker for their hardhat that verifies they have attended the training. When any potential ACM is encountered in soil, work activities will stop, and the HSO and Environmental Manager will be contacted.

When potentially hazardous building materials are sampled for the presence of ACM all individuals conducting sampling activities must be certified by the state of Colorado. Certification under the CDPHE Air Quality Control Commission Regulation No. 8 is required for Asbestos Building Inspectors. Prior to being eligible to take the State CABI exams, federal training class through a USEPA approved training course is required. Furthermore, the CDPHE Solid and Hazardous Waste Commission's Regulations has additional requirements for asbestos in soil and requirements pertaining to Solid and Hazardous Waste in Colorado (6 CCR 1007-2).

Per the CDPHE regulations, additional training and air monitoring for asbestos is required for employees performing asbestos abatement activities in accordance with Regulation No. 8. Under the OSHA Asbestos standard 29 CFR 1926.1101, the employer will provide worker training and an exposure assessment is required for workers potentially exposed to asbestos above the PEL and excursion limit. OSHA also has requirements under the hazard communication standard 29 CFR 1910.1200 and 29 CFR 1926.59.

4.1.4 LEAD AND HEAVY METAL BASED PAINT

Soil, bridge and highway structures, sign posts, and building materials at this Site may contain lead and other heavy metals including arsenic, cadmium, chromium, zinc and other heavy metals. KMP and KIC subcontractor personnel who will potentially be disturbing lead and heavy metal-based paint will have additional training on the OSHA Lead in Construction standard (29 CFR 1926.62)

When potential hazardous building materials are sampled for the presence of LBP and heavy metal-based paint, all individuals conducting sampling activities must be certified by the state of Colorado. Certification under the CDPHE Air Quality Control Commission Regulation No. 19 is required for Lead-Based Paint Inspector. Prior to being eligible to take the State LBP exams, federal training class through a USEPA approved training course is required.

Under the OSHA lead in construction standard 29 CFR 1926.62, the employer will provide lead worker training and an exposure assessment is required for workers potentially exposed to lead above the OSHA PEL and action level. See Appendix J for management of structures with lead and heavy metal paint. OSHA also has requirements for exposure monitoring for other heavy metals such as chromium, arsenic, cadmium and other heavy metals where employee exposure may be above the respective PELs and action levels. Specifically, under 29 CFR 1926.1126 (Hexavalent Chromium), 29 CFR 1926.65 1926.1127 (Cadmium), and additional training requirements under the hazard communication standard 29 CFR 1926.59 and 29 CFR 1910.1200.

4.1.5 RESPIRABLE CYSTALLINE SILICA

Respirable crystalline silica includes very small particles at least 100 times smaller than ordinary sand which is created when cutting, sawing, grinding, drilling, and crushing stone, rock, concrete, brick, block, and mortar. Activities such as abrasive blasting; sawing brick or concrete; cutting, sanding or drilling into concrete walls; grinding mortar; manufacturing brick, concrete blocks, stone countertops, or ceramic products; and cutting or crushing stone result in worker exposures to respirable crystalline silica dust. Industrial sand used in certain operations, such as foundry work and hydraulic fracturing (fracking), is also a source of respirable crystalline silica exposure. Workers who inhale these very small crystalline silica particles are at increased risk of developing serious silica-related diseases, including: Silicosis, an incurable lung disease that can lead to

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disability and death; Lung cancer; Chronic obstructive pulmonary disease (COPD); and Kidney disease.

OSHA has updated the Respirable Crystalline Silica standard with the OSHA Final Rule to protect workers from exposure to respirable crystalline silica. The OSHA Final Rule (29 CFR 1926.55), effective September 23, 2017, for Construction Industry has a PEL for respirable crystalline silica at 50 micrograms per cubic meter (µg/m3) and an Action Level (AL) of 25 µg/m3.

4.1.6 METHANE AND LANDFILL GASES

When working near a potential historical landfill, a variety of potential hazards may be encountered, including exposure to VOCs, methane; fire and explosion hazards in confined or enclosed spaces; the presence of hydrogen sulfide (H2S) gas; oxygen deficiency in underground trenches, vaults, and/or conduits; dust and other contaminants; collapse of excavated materials; buried drums or other containers; and buried sharps such as metal objects and broken glass. Methane (CH4) is typically the constituent of landfill gas that is likely to pose the greatest explosion hazard. Methane is a flammable gas that is lighter than air. The potential for a gas to explode is determined by its LEL and upper explosive limit (UEL). The LEL and UEL are measures of the percent of a gas in the air by volume. At concentrations below its LEL and above its UEL, a gas is not explosive. However, an explosion hazard may exist if a gas is present in the air between the LEL and UEL and an ignition source is present. In addition, an explosion hazard may exist if a gas is present at a concentration above the UEL, and air is introduced into the space, diluting the concentration to the explosive range.

Methane is explosive when air levels are between its LEL of 5% by volume and its UEL of 15% by volume. Also, oxygen is a key component for creating an explosion, but the biological processes that produce methane require an anaerobic, or oxygen-depleted, environment. At the surface of the landfill, enough oxygen is present to support an explosion, but the methane gas usually diffuses into the ambient air to concentrations below the 5% LEL. In order to pose an explosion hazard, methane must be present between its LEL and UEL.

All Site workers should be aware of the potential for methane and carbon dioxide present in the soil, and all activities should be undertaken on the basis of an "assumed presence of landfill gas".

Methane is odorless and colorless, although in landfill gas it is typically associated with numerous highly odoriferous compounds, which gives some warning of its presence. However, the absence of odor should not be taken to mean that there is no methane. Methane levels can only be reliably confirmed by using appropriately calibrated portable methane detectors.

- Methane is a flammable gas and will burn when mixed with air to a concentration between approximately 5 and 15 percent. If a mixture of methane and air with a composition between these two values is ignited in a confined space, the resulting combustion may give rise to an explosion. Methane is also an asphyxiant.
- Carbon dioxide (CO2), the other major component of landfill gas, is an asphyxiating gas and causes adverse health effects at relatively low concentrations. The OSHA Permissible Exposure Limit (PEL) for CO2 is 0.5%, as an 8-hour time-weighted average (8-hr TWA) exposure. Like methane, it is odorless and colorless and its presence (or absence) can only be confirmed by using appropriately calibrated portable detectors.
- Landfill gases are likely to have a density close to or equal to that of air. However, site conditions may result in a ratio of methane to carbon dioxide that may make the gas mixture lighter or heavier than air. As a result, landfill gas may accumulate at any level in any voids or confined spaces.

ED_002842A_00000589-00257

- During all activities, safety precautions should be implemented to minimize the risks of fires and explosions, asphyxiation of workers and toxicity effects resulting from the landfill gas.
- The HSO or MT, specifically trained regarding landfill gas hazards and the appropriate actions to take in adverse circumstances, should be present on the Site throughout the construction operations when excavation or other subsurface activities are performed.
- All personnel who work inside a trench or excavation should be made aware of the fire and explosion hazards associated with the methane gas.

Project-specific air monitoring requirements and designated project Action Levels are discussed in Section 7.

4.2 PHYSICAL HAZARDS

Roadway construction and earth moving activities at the site typically involve a significant number of physical hazards including: heavy equipment operation, trenching and excavation operations, buried and overhead utilities, material handling, risk of slips, trips, and falls, burns, cuts, abrasions, falling objects, heat/cold stress, and noise. There is also a potential for a water hazards, since some of the construction activities on this project are in low lying areas where significant precipitation events may overcome existing storm sewer capacity and flooding may occur in low lying areas.

Furthermore, it may be required that project activities are scheduled to be conducted within the existing railroad ROW. A railroad flagman will be required to be on-site during all activities within the ROW. The construction horizontal clearance zone will be a minimum of 15 feet horizontally from the centerline of the track.

Engineering and administrative controls will be given priority for minimizing employee exposure to physical hazards. When engineering and administrative controls are not feasible, personal protective equipment (PPE) will be used to reduce worker exposure. A detailed discussion of PPE is provided in Section 5.

Additional information on potential site hazards associated with construction work activities are provided in Section 4 and throughout this Health and Safety Plan. The primary physical and environmental hazards associated with the highway reconstruction work activities include:

- Heavy equipment used during demolition of existing bridge structures: Struck by, struck against, material handling, falling objects
- Electrical (fire): Use of electrical power that results in electrical overheating or arcing to the point of combustion or ignition of flammables, or electrical component damage
- Electrical (shock/short circuit): Contact with exposed conductors or a device that is incorrectly or inadvertently grounded
- Explosion/fire, from accidental contact with underground electrical and natural gas line utilities
- methane explosions from landfill gases
- Ergonomics (strain): Damage of tissue due to overexertion such as strain and sprains, or repetitive motion
- Fall (slip, trip): Conditions that result in falls (impacts) from height or traditional walking surfaces
- Trenching and Excavation cave-in and unstable surfaces close to the excavation
- Fire/Heat: Temperatures that can cause burns to the skin or damage other organs. Fire requires a heat source, fuel, and oxygen

ED_002842A_00000589-00258

- Mechanical failure: Typically occurs when devices exceed designed capacity or are inadequately maintained
- Mechanical: Skin, muscle, or body part exposed to crushing, caught-between, cutting, tearing, shearing items or equipment
- Mechanical/vibration (chaffing/fatigue): Vibration that can cause damage to nerve endings, or material fatigue that results in a safety-critical failure
- Noise: Noise levels (> 85 decibels [dBA] 8-hour time weighted averages [TWA]) that results in hearing damage or inability to communicate safety-critical information
- Struck by (mass acceleration): Accelerated mass that strikes the body causing injury or death
- Struck against: Injury to a body part as a result of coming into contact of a surface in which action was initiated by the person
- Visibility: Lack of lighting or obstructed vision that results in an error or other hazard
- Radiation (non-ionizing): Ultraviolet (UV), visible light, infrared, and microwaves that can cause injury to tissue by thermal or photochemical means
- Weather events (snow/lightning/thunderstorms/rain/wind/ice)
- Flooding during high precipitation impacting areas near South Platte River or other low-lying areas
- Natural phenomena (earthquakes, tornados)
- Biological hazards (poison ivy, biting/venomous ants, chiggers (mite larvae), bees, wasps, yellow jackets, ticks, potentially venomous spiders, venomous snakes): Direct contact with poisonous plants or insect bites can cause skin irritation, or insect bites or animal bites can transmit disease or inject venom
- Temperature extremes (heat/cold)

4.2.1 HAZARD CONTROLS

Site conditions such as heavy equipment, trenches and excavations, vehicle traffic, work operating conditions, inclement weather, and equipment from third-party subcontractors working on site pose a variety of physical hazards. KMP, KIC and Contractor personnel are required to adhere to the safety procedures specified in the Project Safety Management Plan (SMP) while performing site work activities. The only means to prevent injury from these hazards is to maintain control of KMP and KIC's work zones and to carefully traverse other areas of the Site. When traversing the site, KMP and KIC and its subcontractors will control and secure all equipment and supplies to prevent accidental release, slips, or driver distraction while traversing the Site. Additionally, all mobilization pathways will be visually cleared before equipment or vehicles are moved.

Many of the work tasks that KMP and KIC and their subcontractors will conduct present unique physical hazards that may not be apparent to Site employees, visitors, or other Site subcontractors. Field personnel must be aware of the inherent risk of working near or around heavy equipment (e.g., drill rigs, excavator, backhoe, cranes, lifts, etc.), using energized field equipment (e.g., pumps, generators), and using other hand tools (e.g., hand augers, hand and power tools). KMP and KIC work zones will be continuously monitored to prevent unauthorized entry and to control potential physical hazards within the work zones. For example, KMP and KIC subcontractors are expected to use and store their equipment in a manner that prevents accidental movement or falling.

For tasks that KMP and KIC personnel and contractors will perform that have established SOPs referenced in the work plans, all personnel should review the appropriate SOP prior to initiating the work tasks. Some tasks may not have established SOPs, in such cases the tasks will be discussed, and hazards will be identified by the field personnel before starting the task. Line-of-

ED_002842A_00000589-00259

sight need not be maintained for all activities due to the size of the Site. However, all KMP and KIC employees and subcontractor supervisor personnel will have mobile phones when working onsite to ensure a line of communication with other KMP and KIC field team members, subcontractors, site personnel, and emergency services. During the daily health and safety briefing, the following should be discussed:

- the locations of the activities to be performed that day such that all personnel are aware of potential site hazards and safe work procedures for the Site operations conducted in that area
- organization of activities so that a minimum of two workers are on Site during work activities

4.2.1.1 Trenching, Excavation and Subsurface Drilling

During trenching and excavation and subsurface drilling operations conducted on the site, KMP and KIC and their subcontractors will follow the requirements specified in the Project SMP Appendix A (Trenching and Excavation Safety Procedures) developed for the site for safe implementation of the project work and use of heavy equipment. The work will be performed in accordance with OSHA Construction Industry regulations under 29 CFR 1926, Subpart P.

4.2.1.2 Landfill Materials

Excavations of soil and waste material, including municipal solid waste in areas of a former landfill at the site pose a variety of potential hazards that may be encountered, including exposure to solvent vapors, dust, and other contaminants; flammable gases (methane); collapse of excavated materials; buried drums or other containers; buried sharps such as metal objects and broken glass; noise and other physical hazards associated with equipment operation. Work practices will be designed to minimize exposure to potential hazards in accordance with the Project SMP for the site. Competent persons, as defined by the SMP will oversee all excavation work. Heavy equipment will be operated only by trained and certified individuals. All personnel on site will be trained in hazard recognition and avoidance and use of the proper personal protective equipment. Air monitoring will be conducted during all intrusive activities in or around areas landfill areas to ensure that the concentrations of flammable and toxic gases are within acceptable limits.

4.2.1.3 Flora and Fauna

Flora and fauna that may be encountered on site include contact with poisonous snakes, spiders, bee and wasp stings, biting insects and poisonous plants. Direct contact with poisonous plants (poison ivy) or insect bites can cause skin irritation. Insect or animal bites can transmit disease or inject venom.

Site personnel will take preventative measures when working on site including avoiding direct contact with biological hazards, wearing PPE and follow procedures specified in the Project SMP and field personnel should be aware of the potential presence of snakes, spiders, wasps, bees, animals and biting insects, particularly when working outside, around existing structures, and when opening well vaults or underground structures. Site personnel will wear protective gloves and other PPE in accordance with the Project SMP to protect limbs when working in potentially hazardous areas where contact with biological hazards may exist. Insect repellent containing DEET should be used to prevent tick and mosquito bites.

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4.2.1.4 Flooding and High Precipitation Events

The water level in the South Platte River can change rapidly during precipitation events and could pose a danger to workers on the banks. Releases upstream, rains in the area, as well as precipitation far upstream of the site affect water levels. Since there is no control over the water levels, workers in areas near the South Platte River or low-lying areas of the project site should be aware of potential flooding areas and river levels and to halt work and move to higher ground as soon as a change in water level occurs.

4.2.1.5 Hazardous Building Materials

During the sampling of hazardous building materials, samplers will collect debris and dust using vacuum cleaners equipped with a HEPA filter. For all types of work that manipulate ACM, wetting of the material to be disturbed is required, and prompt clean-up and disposal of wastes and debris contaminated with potential ACM in leak-tight containers. The following sample collection methods are prohibited during the collection of ACM and LBP samples:

- high-speed abrasive disc saws that are not equipped with point of cut ventilator or HEPA filtered exhaust air
- compressed air
- dry sweeping or shoveling

Additionally, access to sampling areas will be limited to individuals wearing appropriate PPE.

5 Personal Protective Equipment

Personal protective equipment (PPE) will be used to reduce employee exposure to chemical, physical, and environmental hazards that cannot be abated through engineering and/or administrative controls. The use of PPE will be in accordance with the Project SMP and the KMP and KIC PPE Program. These programs were prepared to provide information regarding training on the use of PPE; hazard assessments; PPE selection; PPE use, effectiveness, maintenance, replacement, and storage; PPE limitations; and PPE disposal. The program complies with the requirements of the OSHA standards (29 CFR 1910 Subpart I).

5.1 LEVEL OF PROTECTION

Any KMP and KIC personnel and their subcontractors that handle contaminated soil (i.e., collect samples or handle the soil with their hands), if encountered, will have completed a minimum of 24-hour initial HAZWOPER training and annual refresher training in accordance with 29 CFR 1926.65. 40-hour HAZWOPER training is required if working on a hazardous waste site or working in uncontrolled hazardous waste areas where there is a potential to exceed OSHA PELs for respective COC. PPE including respiratory protection must be selected which will provide protection from the specific hazards which are likely to be encountered during work on the project.

KMP and KIC personnel and subcontractors working with potential COCs will be required to understand the hazards detailed in this HASP. Additionally, KMP and KIC subcontractors will be responsible to provide appropriate PPE for their employees. All KMP and KIC personnel and their subcontractors will have received training for all assigned PPE before any work task begins.

Most activities are expected to be performed in what KMP and KIC considers modified Level D PPE. Modifications to this level of PPE are permitted with review and permission by the Environmental Manager and the HSO. These changes will be communicated to the Project

ED_002842A_00000589-00261

Manager who will then inform other members of the project team. Levels of protection should be selected based on the following:

- type and concentration of the chemical substance in the ambient atmosphere and its toxicity
- potential for exposure to substances in air, liquids, solids, or other materials personnel may come into contact with during the work
- knowledge of chemicals present along with their properties such as toxicity, route of exposure, and contaminant matrix

KMP and KIC does not anticipate any activities to require Level B, or Level A PPE; however, some work activities will require Level C PPE.

The current PPE assessment was based on the anticipated hazards of work activities using existing readily available site investigation information. Proper modifications to the level of PPE to be used will be made as necessary. Types of sampling that may be performed include instantaneous and continuous organic vapor monitoring, instantaneous and continuous particulate matter monitoring, and OSHA and NIOSH reference method sampling. This monitoring would be performed at a frequency and duration adequate to assess potential hazards.

5.2 LEVEL D AND MODIFIED LEVEL D

At a minimum, KMP and KIC employees and subcontractors will wear level D PPE as specified in the Project SMP for all field activities at the site. KMP and KIC's Modified Level D PPE will consist of the following equipment:

- Foot Protection in accordance with requirements of the Project SMP
- Safety glasses: ANSI Z87.1 approved eye protection
- Hard hats
- Task appropriate work gloves: Canvas, cotton, and/or leather (required for all tasks requiring hand and/or power tools)
- High visibility safety vest
- Weather appropriate work clothes (e.g., long pant, shirt with sleeves)

KMP and KIC and their subcontractors will be required to wear Modified Level D which includes all the requirements of Level D PPE and the use of the following PPE where potential to encounter COC or elevated noise levels and where specified in accordance with the Project SMP.

- Hearing protection
- Chemical protective gloves: Nitrile, Viton, neoprene, or butyl (required when handling potentially contaminated materials)

5.3 LEVEL C

Level C PPE will consist of the same items listed for Level D and include a NIOSH-approved air-purifying respirator (APR) in accordance with the Project SMP. Some work activities may require the respirator to be equipped with P100 particulate cartridge and/or combination organic vapor and P100 particulate respiratory cartridge, and chemical-resistant coveralls, gloves and safety boots. Procedures for donning Level C PPE are included in Appendix B.

Individuals conducting ACM and/or LBP abatement and/or sampling will wear an appropriate respiratory protection in accordance with OSHA regulations. Additionally, these individuals will wear disposable protective clothing, including but not limited to, coveralls fitted with a hood, gloves, and foot covers.

ED_002842A_00000589-00262

Contractors will provide their respective employees with respiratory protection training, fit testing, medical surveillance, and have a written Respiratory Protection Program that is compliant with the OSHA Respiratory Protection Standard (29 CFR 1910.134).

5.4 UPGRADING/DOWNGRADING

The level of PPE (e.g., Level D or Level C) may be upgraded or downgraded by the HSO or MT based on changes in conditions or findings and with monitoring information from the HSO (see Section 7). When a significant condition change occurs, work activities will be halted, and the job hazards and appropriate PPE will be reassessed. Some indicators for hazard reassessment are as follows:

- Start of a new work phase (e.g., start of work on a different area)
- A change in job tasks during a work phase
- Change in work method (e.g., changing equipment being used)
- A change of weather
- Encountering contaminants at higher concentrations than expected
- Encountering contaminants other than those previously identified
- A change in ambient levels of contaminants caused by Site operation or release
- A change in work scope that affects the degree of contaminant contact

5.5 INSPECTION

Proper inspection of PPE features several sequences of inspection depending on specific articles of PPE and its frequency of use. The different levels of inspection are as follows:

- Inspection and operational testing of equipment received from the factory or distributor
- Inspection of equipment as it is issued to workers
- Inspection before it is donned
- Inspection after use and during decontamination
- Periodic inspection of stored equipment
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment or when problems with similar equipment arise

Inspection of PPE will be in accordance with the Project SMP and will occur before use and will be conducted by the user.

6 First Aid and Safety Equipment

During field activities, several pieces of safety equipment will be provided near the work area. A PID will be used to detect organic vapors in the breathing zone of the workers and upwind and downwind of each work location. It will also be used to measure background air concentrations before the start of work. A gas monitor with an LEL sensor will be used to screen work areas where there are suspected landfill gases.

Each contractor will ensure a standard first aid kit is their respective project work site for use in the event of an emergency. Such kits will be contained in weatherproof containers with individual sealed packages for each type of item. The kits will contain, as a minimum, the items specified in Appendix A of 29 CFR 1910.151, which are as follows:

- gauze roller bandages, 1 inch and 2 inch

ED_002842A_00000589-00263

- gauze compress bandages, 4 inch
- adhesive bandages, 1 inch
- triangular bandages, 40 inch
- ammonia inhalants and ampoules
- antiseptic applicators or swabs
- burn dressing
- eye dressing
- wire or thin board splints
- forceps and tourniquet

Each contractor is responsible for providing first aid kits to their employees, which the employees will maintain with them onsite at all times. On-Site Health & Safety is responsible for checking the kits to ensure they are fully stocked. When there is a potential for the eyes or body to be exposed to injurious corrosive materials, a means to flush the eyes and/or body will be included with the standard first aid kit.

Additionally, fire extinguishers, electrical equipment and wiring shall conform to the applicable requirements of 29 C.F.R. 1926 and 49 C.F.R.

Awareness of the location of the nearest telephone, potable water supply, and sanitary facility during each field activity will be acknowledged by all appropriate personnel.

7 Air Monitoring

The volatile COCs that could be detected in soil and groundwater include benzene, TCE, PCE, and daughter products including VC, depending on the work location. This does not preclude the chance of encountering other chemicals while onsite. All activities and associated levels of protection described herein are subject to actual field conditions and thus may change during the field activities.

During drilling and excavation activities, real-time air monitoring will be performed for VOCs by qualified personnel. Work will be initiated in Level D. The HSO, or MT, will scan the breathing zone of the workers during all proposed activities with a calibrated PID with a 10.6 eV lamp to monitor levels of organic vapors. Based on site-specific conditions and observations made by the MT, an UltraRAE benzene monitor may be used to measure concentrations of benzene and Dräger sampling tubes may be used to detect specific compounds, such as benzene or VC for example. Real-time air monitoring should be conducted in the breathing zone and directly upwind of the field personnel.

Monitoring equipment used to detect flammable gas, oxygen level, and toxic gas will be capable of detection to meet the following standards:

Instrument Detection		
Constituent	**Threshold Limit**	**Increments**
Flammable Gas	1% LEL	1%
Oxygen	19%	1%
Toxic Gas	1 PPM	1 PPM

LEL = lower explosive limit

PPM = parts per million

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Real-time air monitoring concentrations will be compared to the action levels. If action levels are exceeded, required actions are provided below.

Table 7.1 VOC Air Monitoring Action Levels

Parameter	Action Level	Required Action
Organic vapors	≥ 5 ppm	Notify the HSO. Conduct compound specific (e.g., benzene) sampling using Dräger sampling tubes or an UltraRae. If specific compounds are confirmed, don full-face air purifying respirators (Level C PPE). HSO or designee will investigate source and determine additional monitoring requirements, which may include sampling and/or exposure assessment. Monitor the breathing zone continuously.
	≥ 10 ppm	Stop work and move away from the source. Notify the HSO. HSO will investigate source and determine additional actions. Continue to monitor work area.

7.1 PARTICULATES

Periodic particulate (dust) monitoring will be conducted when drilling and excavation activities are performed to ensure that suspended particulate matter is below site action levels. When working in areas with known heavy metal contamination exists in the soil within the boundaries of areas affected by Asarco and/or the Vasquez and I-70 smelting operations, a site action level of 1 mg/m^3 for airborne dust will be used in order to be protective of workers respective to potential exposure to heavy metals including lead, arsenic, and cadmium in the soil and to ensure worker exposure to heavy metals in the airborne dust does not exceed the respective OSHA PELs. For areas where heavy metal contamination is not suspected, an air borne dust level of 2.5 mg/m^3 will be employed. If the work areas exceed the site action levels, the contractor will implement dust control measures. If dust levels continue to exceed site action levels, employees will don a full-face respirator with P100 filters.

7.2 EXPLOSIVE VAPORS AND OXYGEN DEFICIENT ATMOSPHERES

When drilling occurs near historical landfills, additional air monitoring should be performed for potential landfill gases including oxygen, methane, carbon monoxide, hydrogen sulfide, and sulfur dioxide. At a minimum, a gas monitor or combination of gas meters should be used that measure percent (%) oxygen, % LEL and concentrations (in ppm) of carbon monoxide, hydrogen sulfide, and sulfur dioxide. Real-time air monitoring should be conducted in the breathing zone and directly upwind of the field personnel.

When drilling, trenching, or excavating in the presence of detectable concentrations of explosive gases, the soil will be wetted, and the operating equipment will be provided with spark proof exhausts.

Real-time air monitoring concentrations will be compared to the action levels. If action levels are exceeded, required actions are provided below.

ED_002842A_00000589-00265

Table 7.2 Landfill Gas Air Monitoring Action Levels

Parameter	Action Level	Required Action
LEL (%) **Explosive Vapors and Methane**	≥ 10 %	Stop work until concentrations are below 10%. If concentrations remain ≥ 10%, provide ventilation. Continue to monitor work area.
Carbon Monoxide	25 ppm	Stop work until concentrations are below 25 ppm. If concentrations remain ≥ 25 ppm provide ventilation. Continue to monitor work area.
Hydrogen Sulfide	5 ppm	Stop work until concentrations are below 5 ppm. If concentrations remain ≥ 5 ppm provide ventilation. Continue to monitor work area.
Sulfur Dioxide	2 ppm	Stop work until concentrations are below 2 ppm. If concentrations remain ≥ 2 ppm provide ventilation. Continue to monitor work area.
Oxygen	≤19.5% or ≥23.5%	Stop work and evacuate personnel Provide ventilation to increase oxygen concentrations above 19.5% Continue to monitor work area.
Benzene	1 ppm	If concentrations remain ≥ 1 ppm provide ventilation. Continue to monitor work area.
Other Toxic Gases	PEL	Operations will be discontinued, and personnel removed from affected areas

8 Site Controls and Decontamination

The following section defines the measures and procedures for maintaining Site control (i.e., work zone access) and decontamination. Site control is an essential component in the implementation of the health and safety program; decontamination procedures will ensure that hazardous materials are not removed from the work zones and that offsite exposure risks are minimized.

ED_002842A_00000589-00266

8.1 LONE WORKING

Employees should not be sent out to work alone in the field whenever possible. This must be considered during task assignment and work preparation planning. Should lone working be required, the following must be adhered to:

- Section 8.3 includes provisions for communication prior to departure, during the work, and upon completion of the task whether returning to the office or going to another location.
- The Project Managers must consider the level of competence of the individual being sent to perform the work. Under no circumstances will interns be sent out to work alone. By signing the HASP, the Project Manager acknowledges that the appropriate staff is selected for all work especially for lone working conditions.

8.2 SITE/FACILITY ENTRY

Access to individual proposed work areas will vary depending on the property and location. Most of the reconstruction activities will either be in the I-70 corridor or street ROWs. If unexpected contamination is encountered, designated work zones will be established by the HSO or Environmental Manager or designee and appropriate restrictions will be communicated to all persons on the Site.

An Exclusion Zone (EZ) and Contamination Reduction Zone (CRZ) will be established for work areas that present a significant risk of exposure to hazardous materials. Operations in an EZ will be conducted in accordance with an EZ operations permit. The EZ and CRZ will be delineated by appropriate physical barriers. The EZ and CRZ will remain in place until the work is completed. EZ and CRZ boundaries may be modified by the HSO as needed. The decision to modify a zone boundary or to modify required PPE, environmental monitoring, or other operational requirements can only be made by the HSO as appropriate to the type of hazard.

If on-site work activities, ingress, or egress will significantly impact local traffic patterns, KMP and KIC will utilize flagmen and/or signage, as necessary, to minimize the potential for accidents.

8.3 SITE COMMUNICATION

8.3.1 DAILY HEALTH AND SAFETY BRIEFING

At the beginning of each work day and before any work starts, KMP and KIC subcontractors will have their site supervisor or safety person review activities scheduled for the day and the job hazards associated with those tasks with the Field Team prior to start of work. The site supervisor will note the names of all attendees in the mini JHA on a daily basis. At this time, any health and safety concerns (e.g., accidents, incidents, or near hits) identified by the HSO, Field Team or KMP or KIC subcontractors will be discussed. The HSO, their designee or MT, and KMP or KIC supervisors will communicate any changes to the site HASP that are implemented to be protective of potential site contamination.

8.3.2 LONE WORKING

Lone working will be permitted only in accordance with the Project SMP and with review of this section and specific assignment of contact personnel including the Task Project Manager.

ED_002842A_00000589-00267

8.4 DECONTAMINATION

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. It is critical to health and safety at sites where the potential for exposure to hazardous chemicals is present. Decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used on site; it protects all site personnel by minimizing the transfer of harmful materials into clean areas; it helps prevent mixing of incompatible chemicals; and it protects the community by preventing uncontrolled transportation of contaminants from the site. Decontamination facilities shall meet the criteria set forth in the Code of Federal Regulations (29 C.F.R. and 40 C.F.R.).

8.4.1 EQUIPMENT

Equipment decontamination will be conducted in accordance with KMP Field SOP #6 (Appendix B). Water used in the wash-down or decontamination of personnel and/or equipment will be placed on soils designated for off-site disposal or collected and disposed of appropriately. This water contains used detergent and small quantities of residues removed from equipment components during washing down or decontamination. Under no circumstances will wash water be allowed to leave the project site or otherwise be discharged

8.4.2 PERSONNEL

All disposable nitrile or latex gloves will be disposed of in garbage bags and disposed of through an authorized waste hauler. Personal steel-toed boots, hard hat and safety glasses will be wiped down with detergent and water and reused.

8.5 CONFINED SPACE ENTRY

No KMP or KIC personnel or their subcontractors will conduct confined space entry without notifying the HSO and providing a written confined space entry plan, worker training and the implementation of an entry program. All permit and non-permit required confined space entries MUST BE approved by the HSO and will follow the procedures discussed in the KMP Safety Management Plan. Therefore, no attempt will be made to enter any type of confined space without approval. See Appendix H for the Kiewit Confined Space Entry Procedures for the monitoring of permit required confined space entry including requirements for air monitoring the space with a combustible gas indicator (CGI) for percent (%) oxygen, %LEL, H2S, CO and a photoionization detector (PID) to monitor for VOCs when suspect or known contamination exists. The host employer will provide written confined space entry procedures for their work in accordance with the Kiewit confined space entry program. The host employer will notify the HSO, KIC Safety Manager, and Environmental Manager 48 hours in advance of any permit required confined space entry. The written confined space entry plan will identify authorized entrants, attendants, and rescue personnel roles and responsibilities in accordance with OSHA 29 CFR 1910.146. When working in areas of known contamination or when there is a potential to encounter an atmospheric hazard, a site monitoring technician will perform pre-entry and continuous air monitoring during confined space entry using a Combustible Gas Indicator (CGI) for %O2, LEL, H2S, CO and PID for VOCs.

ED_002842A_00000589-00268

9 Emergency Procedures

The KMP Incident Management Plan (IMP) and Crisis Communication Plan (CCP) will be followed for all emergencies encountered on site. The IMP specifies emergency procedures that will be implemented by onsite personnel. Emergency response procedures for KMP and KIC work zones will periodically be discussed for KMP and KIC and their subcontractors. The HSO will be notified of any onsite incidents related to site chemical contamination or COCs. The following sections provide additional information for emergency procedures related to potential COCs related to site soil and ground water contamination.

9.1 PERSONNEL ROLES AND LINES OF AUTHORITY

The HSO, MT, and KMP and KIC subcontractor supervisors have primary responsibility for responding to and correcting emergency situations affecting project personnel for responding to COCs related to site soil and ground water contamination. Possible actions may involve evacuation of personnel from the work zones where potential site COCs exists. The MT and the HSO will work with the Environmental Manager and KMP and KIC superintendents in accordance with the Project IMP and CCP for potential hazards related to the operation equipment in areas of potential site COCs may be encountered.

9.2 EVACUATION ROUTES AND PROCEDURES

KMP and KIC superintendents and subcontractor supervisors will record the names of site personnel during the daily safety briefing. If soil or groundwater contamination associated with site COCs is encountered, the safety briefing records will be used to ensure that all people working on the Site are accounted for during an evacuation. KMP and KIC and their subcontractors will plan evacuation routes prior to performing work activities which will be implemented in accordance with the Project SMP, IMP and CCP.

9.3 EMERGENCY CONTACTS

In event that a work-related injury, medical assistance or medical emergency is encountered on site, KMP and KIC and their subcontractors will refer to the Project IRP for detailed information on emergency procedures and OSHA requirements, including applicable governmental notification procedures. The following telephone numbers, addresses, and directions for the nearest medical treatment facilities are provided here for reference. The HSO will distribute signed copies of this HASP within 5 calendar days after Acceptance by the Department to each emergency response agency servicing the project area and the HASP-designated emergency hospital listed in the table below.

ED_002842A_00000589-00269

Table 9.1 Emergency Contact Information

Agency	Name	Address	Phone Number(s)
Hospital Emergency Room	Saint Joseph Hospital	1375 19th Avenue, Denver, CO 80218	(303) 812-2000
Hospital Emergency Room	University of Colorado Hospital	12605 East 16th Avenue, Aurora, CO 80045	(720) 848-0000
Urgent Care	Concentra Urgent Care	420 East 58th Avenue, #111, Denver, CO 80216	(303) 292-2273
Urgent Care	Concentra Urgent Care	5855 Stapleton Drive North, Suite A-130, Denver, CO 80216	(303) 371-7444
Urgent Care	Concentra Urgent Care	3001 Havana Street, Denver, CO 80238	(720) 458-6825
Emergency Services (Ambulance, Police, Fire Department)			911
Poison Control Center	Rocky Mountain Poison and Drug Center		(800) 222-1222

+A map showing the routes to the hospital and urgent care clinics (from a central location of the project) is provided in Appendix F.

In an emergency, KMP and KIC personnel will initiate first aid and dial 911. Field personnel will notify the Environmental Manager.

9.4 EMERGENCY MEDICAL TREATMENT PROCEDURES

If immediate medical treatment is required, personal decontamination will be delayed until the condition of the victim has stabilized. If decontamination can be performed without interfering with first aid or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury, decontamination will be performed immediately. If an emergency caused by a heat-related illness develops, protective clothing will be removed from the victim as soon as possible to reduce heat stress.

The following standard emergency procedures will be used during the project. The Task Leader will be notified of any emergencies and will be responsible for ensuring that the appropriate procedures are followed.

Minor injuries: If the injury or illness is minor, full decontamination should be completed and first aid administered before the injured is transported to hospital.

Major injuries: If the patient's condition is serious, call 911 from a mobile phone. At least partial decontamination should be completed, but only under the supervision of trained medical professionals. First aid may be administered while awaiting an ambulance or paramedics. The choice of hospital will be made by the ambulance personnel.

Any person transported to a clinic or hospital for treatment should reference this HASP because it provides information of the chemical or chemicals to which the person may have been exposed.

ED_002842A_00000589-00270

9.5 CHEMICAL EXPOSURE EMERGENCIES

9.5.1 CHEMICAL EXPOSURE

Exposure to chemicals can be divided into two categories:

- injuries from direct contact, such as acid burns or inhalation of toxic chemicals
- potential injury due to gross contamination on clothing or equipment

For inhaled contaminants, treatment can only be provided by qualified physicians. If the contaminant is on the skin or in the eyes, immediate measures must be taken to counteract the substance's effect. First aid treatment usually is flooding the affected area with clean water; however, for a select few chemicals, water may cause more severe problems.

When protective clothing is grossly contaminated, the constituents may be transferred to treatment personnel or the wearer and cause injuries. Unless severe medical problems have occurred simultaneously with splashes, the protective clothing should be washed off as rapidly as possible and carefully removed. Portable eye washes will be available to provide a means of flushing and washing such contamination.

If the injury to the worker results from a chemical splash or uncontrolled release, the following first aid procedures are to be instituted:

Eye Exposure: If contaminated solids or liquids get into the eyes, wash eyes immediately at the emergency eyewash station using large amounts of running or flowing water. Obtain medical attention immediately.

Skin Exposure: If contaminated solids or liquids get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. Obtain medical attention immediately when exposed to concentrated solids or liquids.

Breathing: If a person breathes in large amounts of contaminants, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration immediately. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.

Swallowing: When contaminated solids or liquids have been swallowed and the person is conscious, attempt to obtain information from the person to aid in identifying the substance swallowed. Contact the poison control center for further direction.

9.6 FIRE PROTECTION

All on site KMP and KIC personnel and their subcontractors will follow the procedures specified in the Project SMP and IMP for fire protection and emergency procedures. In the event of an onsite fire or explosion, site personnel and the public in the immediate vicinity will be evacuated. KMP and KIC personnel will notify emergency responders or call 911 to initiate emergency response and alert local fire-fighting companies in accordance with the Project SMP, IMP and CCP.

9.7 PERSONAL PROTECTIVE EQUIPMENT FAILURE

If any worker experiences a failure or alteration of personal protective equipment that affects the protection factor, that person will immediately leave the work zone and work will be stopped if necessary. Re-entry will not be permitted until the equipment has been repaired or replaced.

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9.8 OTHER EQUIPMENT FAILURE

If direct reading air monitoring equipment fails to operate properly, the MT will immediately get replacement equipment that is operating properly and notify the HSO to determine the effect of this failure on continuing operations. If the failure affects worker safety or prevents completion of the activity, all personnel will evacuate the work area until the situation is evaluated and appropriate actions taken.

In all situations, when an emergency results in the evacuation of a work area, personnel will not re-enter the area until the following conditions have been met:

- the conditions resulting in the emergency have been corrected
- the hazards reassessed
- the HASP is reviewed

Site personnel have been briefed on any changes in the HASP.

10 Accident and Incident Reporting

All on site KMP and KIC personnel and their subcontractors will follow the procedures specified in the Project SMP and IMP for emergency procedures and incident reporting. In the event of an onsite accident, injury, or near miss, an incident response will be initiated by KMP or KIC personnel in accordance with the Project SMP and IMP. KMP and KIC personnel will take appropriate measures to notify emergency responders or call 911 following specified the procedures. The Environmental Manager will be also be notified in accordance with the Project SMP, IMP and CCP.

11 Safety and Health Training Program

Several levels of health and safety training are required per OSHA and EPA and State regulations for personnel participating in the implementation of field activities. Site workers will be required to follow the provisions of this HASP, OSHA regulations under 29 CFR 1926, CDPHE regulations and any additional instructions of the HSO.

All MTs, and any other Site workers anticipated to handle contaminated soil, must have current training documentation for the following before field activities commence:

- 24-hour HAZWOPER training
- 40-hour HAZWOPER training when on uncontrolled hazardous waste sites
- current 8-hour refresher certificates

For MTs, documentation of this training will be maintained by the Environmental Manager

11.1 HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE TRAINING

Site MTs, or personnel expected to handle hazardous material, will be required to have 24 hours of initial Hazardous Waste Operations and Emergency Response (HAZWOPER) training and 8 hours of refresher training annually. 40-hour HAZWOPER training is required when working on uncontrolled hazardous waste sites where potential to exceed OSHA PELs for respective site

ED_002842A_00000589-00272

COCs. The training program must comply with the requirements of 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training program includes:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on the site
- Use of personal protective equipment
- Work practices by which the employee can minimize risks from hazards
- Safe use of engineering controls and equipment on the site
- Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards
- Elements of a HASP

Site personnel who will be performing trenching and excavation work in Operable Unit 2 for sanitary sewer line installation will have current 40-hour HAZWOPER certification. Supervisors are required to have an additional 8-hour HAZWOPER Supervisor certification.

11.2 FIRST AID

For specific work tasks related to site COCs in accordance with OSHA requirements, specified KMP and KIC personnel are required to have current American Red Cross and/or American Heart Association Heartsaver® certifications in first aid, CPR, and use of an AED. Furthermore, the location of the nearest medical facility, the directions from the Site to the facility, and the telephone number of the facility and the local rescue facility are provided in Section 9.3.

11.3 ASBESTOS AWARENESS TRAINING

Each employee involved in soil disturbing activities when asbestos discoveries are anticipated are required to attend the two-hour asbestos awareness training provided by KMP prior to conducting field work. The awareness training educates each employee regarding the hazards of asbestos and how to identify potential asbestos containing materials in soils. Each trainee is issued a certificate of completion and a sticker for their hardhat that verifies they have attended the training.

11.4 SITE SPECIFIC TRAINING

Daily safety briefings will be held by the respective contractor prior to initiating any site activity and more frequently as necessary to ensure that employees are apprised of the site hazards and that the Site HASP is being followed. The safety briefings will review site-specific atmospheric exposure and physical hazards that may be encountered during site work activities. Furthermore, site personnel will be trained on potential health and safety issues, protective equipment, emergency information and supplies, and to discuss special topics. In addition, each field team will complete a JHA prior to initiating Site activities that lists the procedures for completing the job and identifies the hazards, which will be signed by each employee.

Each employee is required to attend the following KMP provided training: one-hour Site safety training; two-hour asbestos awareness training (required for personnel involved with soil disturbing activities when asbestos discoveries are anticipated) and one-hour HASP training. Each employee will receive a sticker for each training for their hardhat. Documentation of training sessions will be maintained by the Environmental Manager.

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11.5 VISITOR TRAINING

All visitors to the active work areas will be briefed by the KIC Safety Manager, the HSO or MT on health and safety procedures to be followed. The visitors will be briefed on site specific hazards prior to going on to the site.

The Superintendent and Foreman or MT will control visitor entry to the active work areas. No visitor will enter these areas without previously notifying the Superintendent or Foreman or their designee of the visit and providing documentation of training outlined in Section 11.1. KMP and KIC site supervisors, contractor supervisors, or designated safety personnel, HSO or MT will ensure that all visitors have the proper level of PPE for downrange activities and training in the use of the equipment. Visitors who do not have the appropriate training will not be permitted in areas where the use of PPE is required.

12 Medical Surveillance

For certain site activities where, uncontrolled hazardous waste may exist or for personnel performing asbestos or LBP abatement may be required to participate in a medical surveillance program established by their employer. OSHA regulations state that employees involved in certain activities that may expose them to hazardous materials at or above PELs or above the published exposure limit for greater than 30 days per year, or all employees who wear a respirator are required to participate in a medical surveillance program.

The purposes of the medical monitoring program are to ensure employees' fitness for duty (i.e., physically able to perform assigned tasks); to identify any illness or condition that might be aggravated by exposure to hazardous materials or work conditions; to determine if site work has had an adverse effect to employees' health; to certify that each employee can use negative pressure respirators as required by OSHA; and to establish and maintain a medical record to monitor for abnormalities that may be related to work exposure that could increase injury risk for the employee. A medical monitoring program should include the following:

- a baseline physical examination
- a medical determination of fitness for duty by a licensed physician, including work restrictions after any injury or illness that may affect employee safety
- a review of potential project-specific exposures to determine the need for specific biological and medical monitoring
- annual and exit physical examinations with attention given to specific exposures or symptoms

12.1 BASELINE PHYSICAL EXAMINATION

A baseline physical examination will be performed on each employee engaged in hazardous material exposure related activities, as outlined above before any assignment with the potential for exposure to hazardous chemicals. The purposes of this examination are to identify any illness or condition that might be aggravated by exposure to hazardous materials or work conditions; to certify the safe use of negative-pressure respirators (29 CFR 1910.134); and to develop a medical record for the assessment of exposure-related risk. Variable data, such as age, sex, race, smoking, previous employment, and exposure history, that may have a bearing on future examinations after employment begins will be gathered.

The baseline physical examination will include the following:

- medical and occupational histories including completion of a written questionnaire

ED_002842A_00000589-00274

- a complete physical examination, stressing the central and peripheral nervous system; cardiopulmonary system, spine and other musculoskeletal system, abdomen, rectum, and genitourinary system; and skin, including but not limited to an examination of:
  - height, weight, temperature, pulse, respiration rate, and blood pressure
  - head, nose, neck, and throat
  - chest (heart and lungs)
  - resting 12-lead electrocardiogram
  - chest X-ray (posterior-anterior view)
  - a pulmonary function test (FEV1, FVC, and FEV1/FEV ration)
  - an otoscopic examination and an audiogram at 500, 1,000, 2,000, 3,000, 4,000, and 6,000 hertz pure tone in an approved booth, administered by a qualified technician, and the results read by a qualified physician
  - a multichemistry blood panel (e.g., Chem 24), including kidney and liver function tests, complete blood count with differential, and urinalysis with microscopic examination of centrifuged sediment
  - a red blood cell cholinesterase
  - visual acuity testing
- any other tests deemed necessary by the physician due to symptoms, or exposure, or medical history (e.g., blood lead level; urine screen for arsenic, mercury, chromium, and cadmium)

The following information will also be obtained from the employee by the physician to assist in the examination:

- history of respiratory disease
- work history
  - previous occupations
  - problems associated with breathing during normal work activities
  - past problems with respirator use
  - any other medical information, such as:
  - psychological problems or symptoms including claustrophobia
  - any known physical deformities or abnormalities including those that may interfere with respirator use
  - past and current use of medication
  - tolerance to increased heart rate, which can be produced by extra weight, increased workload, and heat stress associated with wearing respirators and protective clothing

For all employees who are or will be exposed to airborne concentrations of asbestos fibers, the physical examination will also include completion of a respiratory disease standardized questionnaire per 29 CFR 1910.1001 Appendix D.

12.2 ANNUAL PHYSICAL EXAMINATION

An examination and updated occupational history will be performed annually during the anniversary month of the baseline physical examination. This annual examination serves to recertify that the employee is able to conduct work activities at hazardous waste and similar sites. The content of the examination may vary based on the nature of the work and potential exposure since the previous exam.

The annual physical examination will include the following:

ED_002842A_00000589-00275

- medical and occupational histories including completion of a written questionnaire
- a complete physical examination, stressing the central and peripheral nervous system; cardiopulmonary system, spine and other musculoskeletal system, abdomen, rectum, and genitourinary system; and skin, including but not limited to an examination of:
  - height, weight, temperature, pulse, respiration rate, and blood pressure
  - head, nose, neck, and throat
  - chest (heart and lungs)
  - resting 12-lead electrocardiogram for employees over 40 years of age at the time of the annual physical
  - chest X-ray (posterior-anterior view) every 5 years or as deemed necessary by a qualified physician. The employee may decline the X-ray unless it is deemed medically necessary by a qualified physician.
  - a pulmonary function test (FEV1, FVC, and FEV1/FEV ration)
  - an annual audiogram is required only for employees subject to high noise exposures (an 8-hour, time-weighted average of 85 dBA or more) or those required to wear hearing protection for extended periods
  - a multichemistry blood panel (e.g., Chem 24), including kidney and liver function tests, CBC with differential, and urinalysis with microscopic examination of centrifuged sediment
  - a red blood cell cholinesterase
- any other tests deemed necessary by the physician due to symptoms, or exposure, or medical history (e.g., blood lead level; urine screen for arsenic, mercury, chromium, and cadmium)

For all employees who are or may be exposed to airborne concentrations of asbestos fibers, the physical examination will also include completion of a respiratory disease standardized questionnaire per 29 CFR 1910.1001 (Appendix D).

12.3 RETURN TO WORK EXAMINATION

Any job-related illness or injury will be followed by a medical examination to determine fitness for duty or possible job restrictions based on the physical findings of the medical examiner.

12.4 EXIT PHYSICAL EXAMINATION

When an employee terminates employment, that employee is required to have an exit physical examination. The content of the exit physical examination will include the following:

- a personal work history (based on specific project histories)
- medical, exposure, and fertility histories
- a complete physical examination, stressing the central and peripheral nervous systems; cardiopulmonary system; spine and other musculoskeletal system; abdomen, rectum, and genitourinary system; and skin, including but not limited to an examination of:
  - height, weight, temperature, pulse, respiration rate, and blood pressure
  - head, nose, neck, and throat
  - chest (heart and lungs)
  - resting 12-lead electrocardiogram
  - chest X-ray (posterior-anterior view)
  - a pulmonary function test (FEV1, FVC, and FEV1/FVC ratio)

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  - an otoscopic examination and an audiogram at 500, 1,000, 2,000, 3,000, 4,000, and 6,000 hertz pure tone in an approved booth, administered by a qualified technician, and the results read by a qualified physician
  - a multichemistry blood panel (e.g., Chem 24), including kidney and liver function tests, CBC with differential, and urinalysis with microscopic examination of centrifuged sediment
  - a red blood cell cholinesterase
  - visual acuity testing
- any other tests deemed necessary by the physician due to symptoms, or exposure, or medical history (e.g., blood lead level, urine screen for arsenic, mercury, chromium, and cadmium)

For all employees who were potentially exposed to airborne concentrations of asbestos fibers, the physical examination will also include completion of a respiratory disease standardized questionnaire per 29 CFR 1910.1001 (Appendix D).

12.5 OTHER EXAMINATIONS

Medical examinations in addition to those described above may be required by the employer or designated medical provider. Additional medical surveillance may be required by OSHA regulations for workers potentially exposed above the OSHA PELs for specific chemicals. In addition, an employee may request a medical examination based on potential exposure history, work-related illness, or any condition which be deemed a potential health hazard during work activities.

12.6 MEDICAL RECORDS

All medical records will be maintained by the examining physician, as well as the medical monitoring provider. Copies of these records are typically transmitted directly to employees shortly after their annual physicals are completed. The employee's medical monitoring program administrator will maintain the certification of fitness provided by the physician, and the exposure records. Employee medical and exposure records will only be made available on written request by the employer or an authorized representative of the employer. OSHA compliance officers do not need to write a request for records that are required for them to evaluate compliance. When records are requested, they will be furnished within 15 days of the request. If OSHA requests records in writing, the written request will be posted in a visible location for at least 15 days (29 CFR 1910.20). Medical records will be kept on file for at least 30 years after termination of employment. If a business ceases without a successor, then OSHA will be notified and may require transfer of the records.

ED_002842A_00000589-00277

13 Certification and Signatures

All site personnel MUST sign below to acknowledge training on the requirements of this HASP.

Table 13.1 HASP Certifications

Signature	Name	Company and Title	Date

ED_002842A_00000589-00278

14 Acronyms

µg/l	microgram per liter
ACGIH	American Conference of Government Industrial Hygienists
ACM	Asbestos Containing Material
AED	Automatic external defibrillator
ANSI	American National Standards Institute
APR	air-purifying respirator
CCR	Crisis Communication Plan
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
COC	Chemicals of concern
CO	Carbon Monoxide
CPR	cardiopulmonary resuscitation
CRZ	Contamination Reduction Zone
dBA	Decibels, A-weighted
DOT	Department of Transportation
DRO	diesel range organics
eV	electron volt
EZ	Exclusion Zone
F	Fahrenheit
FSSC	field site safety coordinators
HASP	health and safety plan
GRO	Gasoline range organics
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSO	Health and Safety Officer
IDLH	immediately dangerous to life or health
IMP	Incident Management Plan
IP	ionization potential
JHA	job hazard analysis
KIC	Kiewit Infrastructure Co.
KMP	Kiewit Meridiam Partners
LEL	lower explosive limit

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mg/m^3	milligrams per cubic meter
MUC	maximum use concentration
NIOSH	National Institute for Occupational Safety and Health
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
ORO	oil range organics
PAHs	polyaromatic hydrocarbons
PEL	permissible exposure limit
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
REL	recommended exposure limit
SMP	Safety Management Plan
SOP	standard operating procedure
SPF	sun protection factor
STEL	short-term exposure limit
SVOC	semi-volatile organic compounds
TLV	threshold limit value
TWA	time weighted average
UEL	Upper explosive limit
UV	ultraviolet
UVA	ultraviolet A
UVB	ultraviolet B
UVC	ultraviolet C
VOC	volatile organic compound

ED_002842A_00000589-00280

15 References

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- United States Department of Labor - Lead Exposure in Construction (Fact Sheet No. OSHA 93-47).
- National Institute for Occupational Safety and Health /Occupational Safety and Health Administration. 1985. Pocket Guide to Chemical Hazards.
- Occupational Safety and Health Administration (OSHA) Construction Industry Standards – 29 CFR 1926.
- Occupational Safety and Health Standards – Lead in Construction, §1926.62, Occupational Safety and Health Administration.
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Figures

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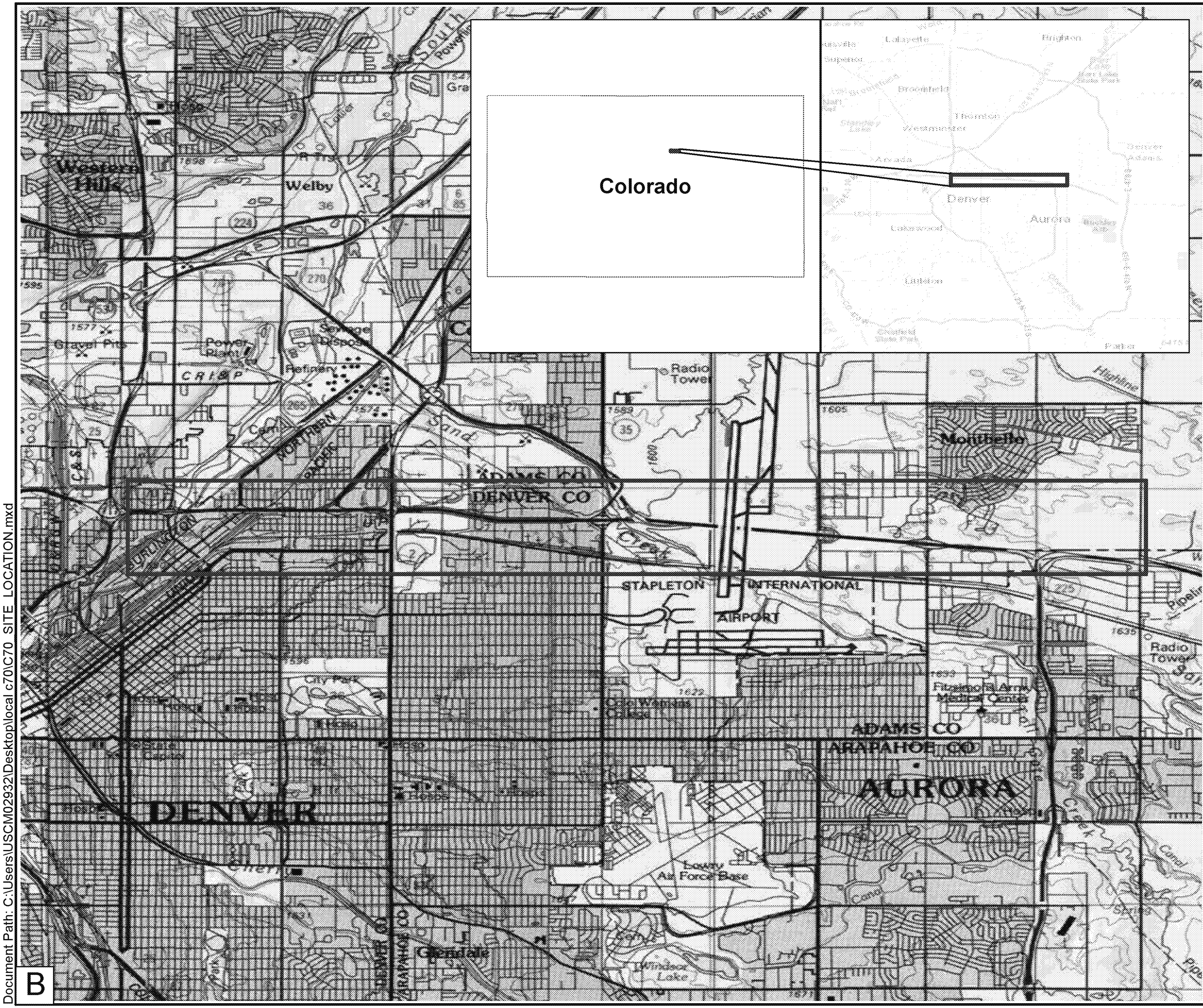


APPROXIMATE EXTENT OF PROJECT AREA

0 3,000 6,000 12,000
SCALE IN FEET

THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK AND WHITE COPIES MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

NOTICE: THIS DRAWING HAS BEEN PREPARED UNDER THE DIRECTION OF A PROFESSIONAL. DO NOT ALTER THIS DOCUMENT IN ANY WAY WITHOUT THE WRITTEN CONSENT OF WSP USA INC.

Drawn By: CDM
Checked:
Approved:
MXD Name:

CDOT CENTAL 70 PROJECT
DENVER, COLORADO
PREPARED FOR
CDOT
DENVER, COLORADO

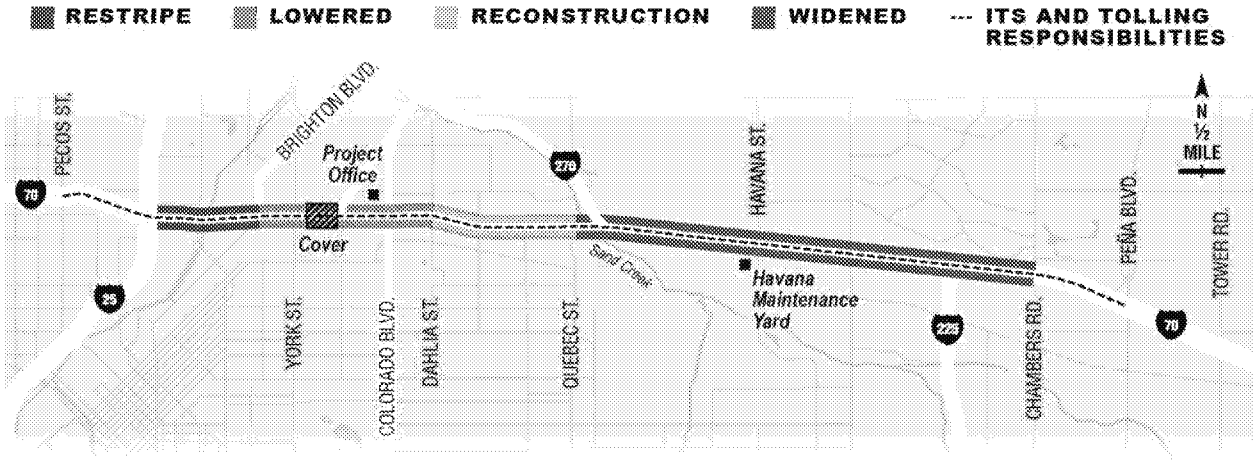
FIGURE 1

SITE LOCATION

WSP USA Inc.
5613 DTC PARKWAY
SUITE 500
GREENWOOD VILLAGE, CO 80111
TEL: +1 303.850.9200

B

Document Path: C:\Users\USCM02932\Desktop\local c70\C70_SITE_LOCATION.mxd


RESTRIPE
LOWERED
RECONSTRUCTION
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ITS AND TOLLING RESPONSIBILITIES
N
½ MILE
PECOS ST.
BRIGHTON BLVD.
Project Office
Cover
YORK ST.
COLORADO BLVD.
DAHLIA ST.
QUEBEC ST.
Sand Creek
HAVANA ST.
Havana Maintenance Yard
CHAMBERS RD.
PEÑA BLVD.
TOWER RD.
76
85
270
225
70

APPENDIX

A UTILITY LOCATION AND PROTECTION PROCEDURES

Kiewit

APPENDIX A

UTILITY LOCATION AND PROTECTION

Policy

All existing utilities will be located, marked, and visually verified prior to starting any operation. The Superintendent and Foreman of each operation is responsible for ensuring that the Dig Permit, Hazard Analysis and all necessary drawings are available and current for review at the operation.

There should be one point of contact (i.e. utility engineer) assigned on each project to ensure that this policy is being implemented and followed. Small projects may not need a solely dedicated person. However, large projects should consider this to be a full time responsibility. One of the utility engineer's duties will be the development of the utility map for the project. This map will include all owner identified utility locations, self-performed installation of utilities, location of utilities that have been pot holed, and height and voltage of identified overhead power lines. Utility maps and as-built drawings should be updated throughout the life of the project as utilities are located and installed.

Any deviation from this policy must be approved by the Area Manager using the Variance Procedure found below. Variances considering life threatening utilities should be avoided whenever possible.

Dig Permit

A Dig Permit is required for all operations, which penetrate the ground surface. The Dig Permit must be updated and relevant to the operation. The Dig Permit has several sections requiring completion.

- General Information: This section is used to describe the work zone for the operation to be performed and includes the location of the work, start and finish dates, and the size of the excavation.
- Locate Service Notification: This section is used to record the locating service information and includes the locate ticket number, description and the date it was requested.
- Pre-Work Checklist: This section is the pre-work checklist and includes a series of questions to ensure that the necessary preventative measures have been taken to prevent a utility strike. This section is to be completed by the responsible Superintendent or Foreman. The questions are of a yes / no nature and must be initialed before excavation operations can begin.
- Utility Checklist: This is a list of normal utilities that can be found in our work zones and is intended as a reminder of what is and could be present.
- Signatures: The Operator, Utility Engineer, Foreman and Superintendent must sign the Dig Permit prior to the start of the operation. Signing the Dig Permit illustrates that you understand what utilities are in the area and the procedures/policies that are required to prevent a utility strike.

Once the Dig Permit has been properly completed, the following documents need to be attached to it before being distributed out to the foreman:

- A detailed drawing showing the work zone covered by the dig permit. This includes the planned work area, current ROW limits, and a copy of the updated utility drawings.

Recognizing Change

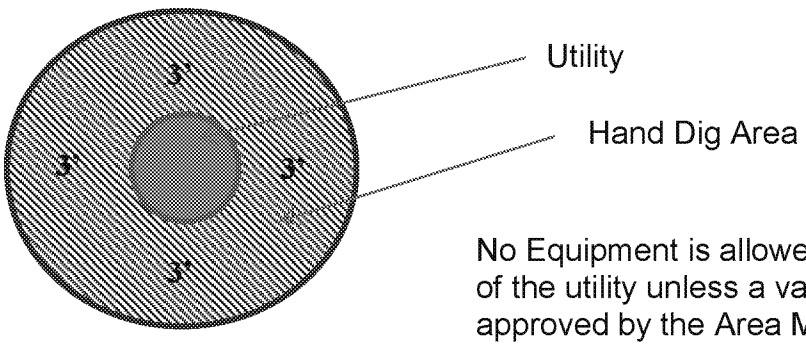
If an operation involving utilities changes or any individual recognizes a change to the original Dig Permit the operation must shutdown until the appropriate changes are made to the original Dig Permit, the Job Hazard Analysis and the crew is properly trained and updated on the plan modifications.

Protecting Exposed Utilities

If during the course of excavation a utility has been exposed, it is our responsibility to inspect, protect and support these utilities. If damage of any kind is discovered, or any suspicion of damage exists, call the utility engineer so documentation can take place. The utility engineer will then notify the utility owner.

3 Foot Rule

The minimum clearance of 3 feet shall be maintained between an underground utility and the cutting edge or point of any power operated excavating or earth moving equipment. If excavation is required within 3 feet of any utility, the excavation will be performed with extreme care utilizing hand tools or vacuum excavation techniques only.



No Equipment is allowed to dig within a 3' radius of the utility unless a variance is obtained and approved by the Area Manager

One-Call Centers

The One-Call Center for your area must be contacted before the start of any excavation. All subcontractors at any level must complete their own one call. Pre-mark the work area of the proposed excavation with white paint, stakes, or flags prior to notifying the One-Call Center.

Never assume that One-Call centers will mark all utilities, it is normal that they only mark certain utilities and the others must be marked using alternative methods.

Most One-Call Centers will require the following information:

- North/East/South/West coordinates (i.e. Street names and/or block numbers) the more accurate the description of the area you give the better.
- The type(s) of work being performed.
- What area is to be marked (i.e. entire roadway or empty field). The area needs to be marked, or set apart, for the locators.

One call centers have differing time frames for request of services and for the duration that the "ticket" will remain open. Please check with your local one call for verification of this time frame.

Utility Color Markings: The following colors and symbols have been adopted by all utilities for marking underground facilities:

	BLUE	Water
	ORANGE	Telephone, Railroad, Cable TV
	GREEN	Sewer, Storm Drain
	RED	Street Lighting, Electric, Traffic Signals (traffic signals may be orange)
	YELLOW	Gas
	PINK	Survey
	WHITE	Proposed Excavation

Note: In some cases, the underground utilities belong to the owner of the property rather than the utility. For example, the utility company may own the gas line up to a meter at the edge of a property. The gas line from the meter on into the property (i.e. a house or commercial building) belongs to the property owner. The utility company will not mark the utilities beyond where they own them.

Traffic signal wires for intersections are not covered by the One-Call Centers. It is the superintendent's responsibility to contact the proper authority to locate the traffic signal wires.

In addition, newly constructed work is not covered by the One-Call Centers (i.e. drainage, ITS, electrical subcontractor new installations, etc.). Their plans will need to be referred to for locations of this work. The engineer, foreman, or superintendent responsible for this work will be contacted to verify what has been constructed.

Field Visit and Verification:

After the One-Call Center has been activated and the 48-hour period is up, a field verification visit is required. The visit is used to verify that the One-Call Center has come out to the work area and marked all utilities. Do not assume "no markings" means "no utilities".

During the field visit, the area must be inspected for any unknown utilities (i.e. landscape irrigation lines). If any unknown utilities are found, they must also be potholed and located.

The One-Call Center markings will be compared to the utility drawings. If one or more One-Call Center members have not marked any or all of the utilities in the area, then call the One-Call Center back and give second notice. The One-Call Center will immediately send the locators out to mark the utilities.

Any utility relocation that have taken place and any new utilities that have been installed need to be noted. In addition, ITMS and new electrical subcontractor installed lines need to be verified.

Potholing

What you don't see can KILL you!

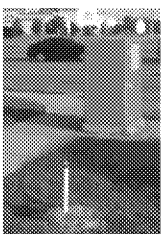
Before excavating operations may begin, potholing for the utilities is required. Potholing is performed to verify the location and depth of the utility lines. Potholing will be done using hand labor or a Vacuum truck. The proper tools that can be used for handwork are shovels and pry bars (or other tools of this nature). Even these hand tools should be used with caution to prevent damaging fragile utilities. At no time should a pickaxe or other similar tools be used. Equipment can be used in conjunction with the hand labor to remove hand-loosened material only.

- Blind Sweep – The use the Ground Penetrating Radar (GPR) and/or Electromagnetic Locator (EM) to locate the utility prior to beginning pothole. The locate devices will also be used to track/trace the utility between pothole locations along the same utility line.

- A Blind Sweep of the work area is required regardless of markings.

YOU WILL POTHOLE TO FIND THE UTILITY. If the utility was not found in the first pothole, do not assume that this utility is not there. The utility must be found prior to the start of the excavation operations.

The soil must be excavated in 6" lifts (approximately) by hand, or by vacuum truck, to verify that no utilities are present. Then the equipment can be used to excavate the material in that lift. If utilities are located, then the utilities must be exposed by hand, no equipment.



Once identified, all utilities will be marked with a PVC marker. The PVC should be painted or marked the appropriate color according to utility type and cut to be uniform. If grade stakes are used they must be painted or clearly marked the appropriate color according to utility type and offset markings clearly noted on the stake. Make sure all personnel are aware of the location of the utilities in the area.

After the utility is potholed and found the location of the utility should be stored using a GPS or other effective means. This information should be used by the Utility Engineer or designee to update the utility drawings.

DO NOT ASSUME THAT THE UTILITY WILL CONTINUE ON THE SAME LINE AND GRADE.

If any damage occurs to any line, contact the utility company immediately.

Pothole Spacing and Frequency

Life Threatening Utilities

- Life threatening utilities such as gas and electrical services will be exposed through the entire length of the excavation.
- Gas and electric lines within 25 feet of your work area will be potholed and marked every 100 feet for design purposes and every 25 feet for construction operations in order to verify that the line has not changed directions.
- Gas and electric lines between 25 and 50 feet of the work zone will be potholed at least once on each end of the limits of the excavation to verify the One-Call Center locates and the utility plans.
- In addition to potholing at the spacing and frequencies shown above, each utility will be tracked using GPR and/or EM locators along the utility between each pothole location.

Communications Lines

- Fiber optic lines will be potholed every 100 feet for design and 25 feet for construction operations
- Telephone and cable will be potholed every 100 feet for design and 50 feet within the work area for construction operations.

Other Utilities

- Utilities not identified above shall be potholed every 100 feet for design and 50 feet for construction operations on lines less than 24" in diameter.

<u>At least two (2) potholes must be obtained for each utility within the work zone regardless of how small the work area is.</u>

Utilities in Roadways

- Utilities that are located within the roadway will be potholed. If the roadway presents too great a risk then other methods to identify the location of the utility may be used but must be approved by the Area Manager.
- Street plates will be obtained to cover a pothole when there is live traffic on the roadway.
- For roadway work not scheduled to be excavated in the current operation, an asphalt patch will be placed over the potholed. This will be done after, and only after, all pothole information has been recorded and the pothole has been offset using stakes and ribbon.
- Once all potholing has been completed excavation can begin. However, you must always keep an eye out for unknown utilities.

The area manager must approve any deviation from the potholing procedures outlined above in writing.

Kiewit

Form Pins, T-Post & Wooden Stakes

Dig Permits are not required when installing form pins, t-posts and wooden stakes unless they need to be placed closer than 3' to an existing utility. The Utility Engineer should be consulted to verify that no utilities will be damaged.

Installed Utility Plan

All work areas will be inspected for installed utilities prior to beginning work. This inspection of the work area will be incorporated with the dig permit for that area.

The following steps will be used to locate installed utilities;

1. A One Call for the area will be made by the Utility Engineer
2. A Dig Permit for the area will be filled out and will include all applicable as-built drawings
3. The superintendent over the operation will perform the blind sweep and review the appropriate as-built drawings/ survey data to mark and locate the utilities.
4. Potholes will be used to locate all installed utilities unless GPS data gathered during installation is present.
5. The superintendent will be responsible for updating locate marks/ feathers as needed.

REPORTING REQUIREMENTS

If a utility strike does occur, several reporting steps are required:

- First, clear and secure the area if there is potential for further exposure to hazards.
- Contact the appropriate utility owner to inform them of the damage so they can inspect and repair, if necessary.
- Notify the Project Manager, Sponsor, Area Manager, District Safety Manger and District Manager.

The project will complete the utility strike report and submit it to the job sponsor and the District Safety Manager within 24 hours.

Kiewit

DIG PERMIT

1. GENERAL INFORMATION

Location of excavation (Attach Plans):

Drawing Numbers of Plans Attached (highlight utilities)

Purpose of excavation:

Start Date:	Expected Completion Date:	Depth:	Width:	Length:

2. LOCATE SERVICE NOTIFICATION

Ticket No.	Date Requested	Requested By.

Description:

3. PRE - WORK CHECKLIST

It is the Superintendent and Foremens responsibility to ensure this section is complete		Initials	
Are all utilities shown on drawings marked in field?	Y / N		If No STOP Varience is required
Are all relocations and installed utilities accounted for?	Y / N		
Has a blind sweep been performed using locating device?	Y / N		
Have you performed a field verification to look for unknown utilities?	Y / N		
Have all utilities been potholed according to policy?	Y / N		
Are utilities safe or protected from being crushed by the equipment?	Y / N		
Does the crew understand the 3ft. hand dig policy?	Y / N		
Are updated utility drawings and any necessary as builts attached?	Y / N		
Has the Hazard Analysis been reviewed?	Y / N		

4. UTILITY CHECKLIST

COLOR	UTILITY	Is Utility present in the work area?
BLUE	Water Systems	Y / N
ORANGE	Telephone & Fiber Optics	Y / N
GREEN	Sanitary Sewer Systems	Y / N
RED	Elec. Power Distribution and Transmission	Y / N
YELLOW	Gas and Oil Products Dis.	Y / N
PURPLE	Reclaimed Water, Irrigation	Y / N
PINK	Survey	Y / N

5. SIGNATURES (All Signatures required.) Pre-Work Checklist is complete and policies/procedures communicated clearly?

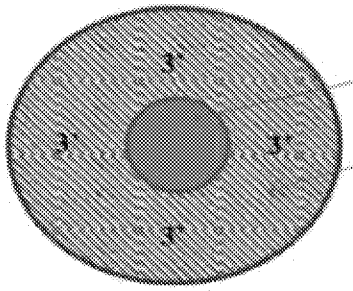
		Signature
Operator	Y / N	
Utility Engineer	Y / N	
Foreman	Y / N	
Superintendent	Y / N	
Crew		

Notes:

Kiewit

3 Foot Rule

The minimum clearance of 3 feet shall be maintained between an underground utility and the cutting edge or point of any power operated excavating or earth moving equipment. If excavation is required within 3 feet of any utility, the excavation will be performed with extreme care utilizing hand tools or vacuum excavation techniques only.



No Equipment is allowed to dig within a 3' radius of the utility unless a variance is obtained and approved by the Area Manager

Pothole Spacing and Frequency

Life Threatening Utilities

- Life threatening utilities such as gas and electrical services will be exposed through the entire length of the excavation.
- Gas and electric lines within 25 feet of your work area will be potholed and marked every 100 feet for design purposes and every 25 feet for construction operations in order to verify that the line has not changed directions.
- Gas and electric lines between 25 and 50 feet of the work zone will be potholed at least once on each end of the limits of the excavation to verify the One-Call Center locates and the utility plans.
- In addition to potholing at the spacing and frequencies shown above, each utility will be tracked using GPR and/or EM locators along the utility between each pothole location.

Communications Lines

- Fiber optic lines will be potholed every 100 feet for design and 25 feet for construction operations
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Other Utilities

- Utilities not identified above shall be potholed every 100 feet for design and 50 feet for construction operations on lines less than 24" in diameter.

<u>At least two (2) potholes must be obtained for each utility within the work zone regardless of how small the work area is.</u>

Kiewit

	Utility Policy Variance Form	Yes	No
1.	Have all aspects of the work been examined to determine if hand digging/ hydro-excavating can be used to perform the work?		
2.	Has the utility owner been asked to move/ relocate the line prior to starting work?		
3.	Has the utility owner been contacted to de-energize the utility?		
4.	Has a verification (lockout/ tag out) method been established with the utility owner to ensure they have properly de-energized the line? (Verbal notification is not acceptable)		
5.	Has the crew been trained on the variance and do they understand how it is to be followed in the field?		
6.	Is the spotter competent? Do they understand their job?		
7.	Will guarding/ shielding be used to protect the utility?		
8.			
9.			

Description of work being performed?

What part of the policy will not be followed due to the variance?

What are we going to do to ensure we do not damage/ strike the utility?

Superintendent **Date**

Project Manager **Date**

Area Manager **Date**

Power Line Permit

Operation:	Date:
Superintendent Responsible:	Dedicated Spotter (Required):
Voltage of line:	Height of line:
Prohibited Zone:	Clearance Distance:
Permit must be updated to reflect changes in operation. Permit must account for any new hazards associated with the change and preventative measures implemented.	

Circle yes or no	
Yes or No	Power Line Permit in the cab of the equipment
Yes or No	Is a competent signal person assigned to monitor the operation with the **sole responsibility** to verify the required clearance is maintained?
Yes or No	Is a competent supervisor present at the equipment during the operation with the **sole responsibility** of verifying all steps of the plan are being carried out and that the specified clearance between the power line and the Equipment or load is being maintained.
Yes or No	Does the Dedicated Spotter have a visual aid to assist in identifying the Prohibited Zone?
Yes or No	Does the Dedicated Spotter understand that he/she must NOT allow the equipment to breach the prohibited zone?
Yes or No	Does the Dedicated Spotter have direct contact with the Operator? (radio or air horn)
Yes or No	Has the Operator and all crew members that are a part of the operation been trained according to policy?
Yes or No	Are power line signs in place far enough in front of the hazard to allow the operator of the equipment adequate time to take evasive action?
If you answered No to any of the above questions STOP the operation!	

Table A – Minimum Clearance Distances

Voltage (Nominal, kV, Alternating	Minimum Clearance Distance
Up to 50	10' (3 m)
Over 50 to 200	15' (4.5 m)
Over 200 to 350	20' (6 m)
Over 350 to 500	25' (7.5 m)
Over 500 to 750	35' (10 m)
Over 750 to 1000	45' (14 m)
Over 1000	(as established by the power line owner/operator or registered professional engineer who is a Qualified person with respect to electrical power transmission and distribution)

Signature of Crew Members

PRINT:	SIGN:
All crew members that are a part of the operation must sign and understand contents of the permit.	

Superintendent Signature:	Date:
Job Superintendent is ultimately responsible for adherence to the Overhead Power Line Policy	

R.E.D. BOOK

NOBODY GETS HURT.

NAME: _____

PROJECT: _____

WHO IS RESPONSIBLE FOR SAFETY?

I AM!

Recognize Eliminate Discuss

The R.E.D. Book program is designed to eliminate unsafe acts by requiring employees to immediately identify and discuss hazards that can hurt them. By recognizing these hazards in advance our employees are less likely to commit unsafe acts.

Requirements

1. Before EVERY change in activity or change of conditions a R.E.D. Book page will be filled out. Anytime that you are unsure of how to proceed safely, it is your responsibility to STOP.
2. Anytime there is a change in the following a R.E.D. Book page will be filled out.
   I. Equipment Malfunction
   II. Materials are different or wrong for installation
   III. New crew members/assist from another crew
   IV. Use of unfamiliar tools or equipment
   V. Anytime that a recognized change in conditions occurs in the operation
   VI. Any change from the way the operation was originally planned
3. R.E.D / Mini Book is in the immediate possession of the Supervisor and will be available to any crew member.
4. No operation will begin without a Work Plan and Hazard Analysis.

Safety is an Attitude.
Safety is our Responsibility.
Who is responsible for Safety?

I AM!

Recognize Eliminate Discuss

Name: _____ Date/ Time: _____

Area: _____ Operation: _____

Task to be performed:

Planned Steps

1)

2)

3)

4)

5)

Crush Points (Be specific)

What can hurt me?

1)

2)

3)

What am I going to do about it?

1)

2)

3)

Access (Ladders, Walkways, Scaffolds, Ramps, Excavations, Overhead, etc...)

What can hurt me?

1)

2)

3)

What am I going to do about it?

1)

2)

3)

Housekeeping (Tripping, Impalement, Material Handling, etc...)

What can hurt me?

1)

2)

3)

What am I going to do about it?

1)

2)

3)

Recognize Eliminate Discuss

Equipment (Moving Parts, Noise, Signals, Communication, Cranes, etc...)

What can hurt me?

1)

2)

3)

What am I going to do about it?

1)

2)

3)

Sprains & Strains (Heavy or Awkward loads, elevated work, get help, etc...)

What can hurt me?

1)

2)

3)

What am I going to do about it?

1)

2)

3)

Other Hazards (PPE , Other trades, Tight work areas, Confined Space, Energized Equip, etc...)

What can hurt me?

1)

2)

3)

What am I going to do about it?

1)

2)

3)

Eye Protection Needed for Task?

1)

2)

3)

Crew Members Sign Below

NOTES:

NOTES:

Hazard Analysis Checklist

Consider the following when planning your work.

Access to work area
- Scaffolding? Ladders? Stairs?

PPE requirements
- Special Requirements?
- Training?

Fall Protection
- Fall Potential?
- Handrails?
- Fall Arrest System?
- 100% Tie Off?

Lockout/ Tag out
- Stored Energy?
- Other Crafts?

Confined Space
- Access/ Egress?
- Hazardous Atmosphere?
- Engulfment?

Working Conditions
- Weather?
- Live Equipment?
- Night work?

Hoisting (Cranes/ Forklifts/ Excavator etc.)
- Know your Weight?
- Qualified Rigger?
- Qualified Signal Person?
- Rigging type? (Nylons/ Wire Rope)

Excavations
- Shoring/ Slope Protection? Soil Type?
- Excavation Inspection?

Employee Commitment to Safety, I will. . .

- Make Safety a value to me
- Never walk by an unsafe act without stopping to correct it
- Speak up when I feel unsafe
- Come to work prepared and focused on safety
- Watch out for my fellow worker

NOBODY GETS HURT.

HAZARD ANALYSIS

ITEMS/PAGE	ITEMS/PAGE	ITEMS/PAGE

NOTES:

NOTES:

HAVE YOU MADE YOUR HAZARD ANALYSIS TODAY?

Date _____

Minor Operation Hazard Analysis

Operation: _____

Procedure:
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
(7) _____

Hazards:
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
(7) _____

Precautions:
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
(7) _____

Signatures: _____ _____

_____ _____ _____

_____ _____ _____

HAVE YOU MADE YOUR HAZARD ANALYSIS TODAY?

Hazard Analysis Checklist

✓ **PPE:**	Proper Personal Protective Equipment
✓ **Access:**	To the work area
	Adequate lighting
	Ventilation
✓ **Tools:**	Tools required
	Tool hazards
✓ **Equipment:**	Equipment required
	Equipment hazards
✓ **Materials:**	Hazardous materials (MSDS)
	Hazards from materials
	Material hoisting/transport
	Material storage
✓ **Hoisting (Cranes):**	Weight of pick
	Swing radius
	Proper signaling/Radios
✓ **Housekeeping:**	Debris handling
	Excess materials
	Tripping/stumbling hazards
	Lunch trash
✓ **Fall Protection:**	Work decks
	Handrailing
	100% tie-off
	Secure tie-off points
✓ **Electrical:**	Assured grounding (tape color)
	Electrical hazards
✓ **Other Items:**	Excavations
	Traffic
	Respiratory
	Torch safety

Every operation requires a Hazard Analysis!

JOB NUMBER

JOB NAME

Power Line Permit

Operation:	Date:
Superintendent Responsible:	Dedicated Spotter (Required):
Voltage of line:	Height of line:
Prohibited Zone:	Clearance Distance:
Permit must be updated to reflect changes in operation. Permit must account for any new hazards associated with the change and preventative measures implemented.	

Circle yes or no	
Yes or No	Power Line Permit in the cab of the equipment
Yes or No	Is a competent signal person assigned to monitor the operation with the **sole responsibility** to verify the required clearance is maintained?
Yes or No	Is a competent supervisor present at the equipment during the operation with the **sole responsibility** of verifying all steps of the plan are being carried out and that the specified clearance between the power line and the Equipment or load is being maintained.
Yes or No	Does the Dedicated Spotter have a visual aid to assist in identifying the Prohibited Zone?
Yes or No	Does the Dedicated Spotter understand that he/she must NOT allow the equipment to breach the prohibited zone?
Yes or No	Does the Dedicated Spotter have direct contact with the Operator? (radio or air horn)
Yes or No	Has the Operator and all crew members that are a part of the operation been trained according to policy?
Yes or No	Are power line signs in place far enough in front of the hazard to allow the operator of the equipment adequate time to take evasive action?
If you answered No to any of the above questions STOP the operation!	

Table A – Minimum Clearance Distances

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Over 500 to 750	35' (10 m)
Over 750 to 1000	45' (14 m)
Over 1000	(as established by the power line owner/operator or registered professional engineer who is a Qualified person with respect to electrical power transmission and distribution)

Signature of Crew Members

PRINT:	SIGN:
All crew members that are a part of the operation must sign and understand contents of the permit.	

Superintendent Signature:	Date:
Job Superintendent is ultimately responsible for adherence to the Overhead Power Line Policy	

APPENDIX

B FIELD STANDARD OPERATING PROCEDURES

FIELD STANDARD OPERATING PROCEDURE #5

INVESTIGATION DERIVED WASTE MANAGEMENT PROCEDURE

The purpose of this standard operating procedure (SOP) is to provide instructions for handling, storing, and managing investigation derived waste (IDW) pending disposal. All IDW, which includes (but is not limited to) soil cuttings, development water, purge water, drilling fluids, decontamination fluids, personal protective equipment (PPE), and sampling equipment, must be managed in compliance with applicable or relevant and appropriate requirements. The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper PPE must be selected and used appropriately.

ACRONYMS AND ABBREVIATIONS

DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
IDW	investigation derived waste
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
SOP	standard operating procedure
TSCA	Toxic Substances Control Act

MATERIALS

- Pre-printed weatherproof waste labels (e.g., nonhazardous waste, hazardous waste, polychlorinated biphenyls [PCBs], etc.)
- IDW log (Figure 1)
- Permanent ink marking pen, paint, stick/pen
- Sampling equipment (refer to sampling SOPs)
- Impermeable covers (tarps), as needed
- Duct tape, rope, or other material to secure tarp
- Copy of the waste manifest or bill of lading

PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company SOPs. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for handling, storing, and managing IDW pending disposal and assumes the user has received current U.S. Department of Transportation (DOT) training, Hazardous Waste Operations and Emergency Response training, and Resource Conservation and Recovery Act (RCRA) training (if required) and is familiar with basic field procedures, such as recording field notes (SOP 1), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), and equipment decontamination (SOP 6). The SOP does not cover investigation planning; DOT, RCRA, and Toxic Substances Control Act (TSCA) regulations; nor does it cover the evaluation of the analytical results. **Consult and involve the company's compliance professionals during all phases of IDW management and disposal.**

It is important to note that information contained in this SOP is based on federal regulations and interpretive guidance provided by the U.S. Environmental Protection Agency (EPA) and other federal regulatory sources; therefore, information provided in this SOP may be superseded by state or local-specific statutes or regulations. Field personnel must plan for and discuss the handling procedures with the project manager and assigned company compliance professional before mobilizing to the field.

IDW GENERAL PROCEDURES

Nearly all intrusive field activities will generate solid or liquid wastes. Examples include:

Solid Waste	Liquid Waste
Soil cuttings	Decontamination water
Drilling mud	Development water
Plastic sheeting	Drilling fluids
Spent carbon or filters	Purge water
PPE (e.g., Tyvek coveralls, gloves, respirator cartridges)	Soap or wash solutions
Disposable or dedicated sampling equipment (e.g., bailers, hoses, clamps, buckets, cartridge filters)	Reagents (e.g., hexane, nitric acid, methanol)
Field analytical waste (e.g., HACH kits, Chlor-n-Soil kits, Gastech tubes)	
Compressed gas cylinders (e.g., isopropylene, helium)	

The specific procedures for dealing with these materials after the field activities have been completed will vary depending on whether the materials are considered to be nonhazardous, RCRA hazardous (characteristic or listed wastes), TSCA-regulated PCB waste, and/or DOT hazardous materials. The characterization of the wastes to be generated should be determined in conjunction with a company compliance professional before the field event occurs, based on previously generated data; however, in some cases, particularly for new sites, the status of the wastes may not be known. In these cases, handle IDW as hazardous waste until the status can be verified. Field personnel must consult their assigned company compliance professionals for assistance in proper waste characterization and to determine waste management requirements applicable to the site.

WASTE MINIMIZATION

As possible, select investigation methods and techniques that will minimize the amount of wastes generated during field activities, particularly if the IDW is hazardous. Examples include using direct-push methods instead of hollow stem augers (to minimize soil cuttings) during a soil investigation, if appropriate, and limiting contact with the materials to reduce the amount of PPE required. Minimizing the amount of waste generated will reduce handling requirements and overall project costs, and is consistent with the company's corporate goals for sustainability.

ONSITE IDW MANAGEMENT PROCEDURES

Onsite handling procedures typically involve containerization of the IDW for offsite disposal at a regulated facility or, in the case of certain nonhazardous wastes, onsite disposal. Should more than one waste stream be present onsite, segregate the IDW containers by waste stream to facilitate the future waste disposal. The procedures for each type of waste are presented below.

NONHAZARDOUS WASTE MANAGEMENT

If information exists to classify the IDW as nonhazardous waste, the following procedures must be implemented only after being discussed and approved by the project manager, project compliance professional, client, facility personnel and/or, if applicable, regulatory agency:

- Soil can be either:
  - spread around the borehole or other onsite location
  - placed back in the boring or excavated test pit
  - containerized and disposed of offsite
- Groundwater and decontamination fluids can be either:
  - poured onto the ground next to the well to allow infiltration
  - discharged to either the publically-owned treatment works or storm sewer
  - discharged to the onsite wastewater treatment plant
  - containerized and disposed of offsite
- PPE, plastic sheeting, and spent bag filters can be double bagged and disposed of as general trash or containerized and disposed of offsite.
- Compressed gas cylinders should be depressurized and disposed of as general trash, recycled as scrap metal, or containerized and disposed of offsite.
- Field analytical waste (e.g., HACH® kits, Chlor-n-Soil® kits) can be disposed of in accordance with the manufacturer's instructions provided the disposal method is approved by the company's project manager and compliance professional.
- Minimize the volume of reagents as much as possible. Consult a company compliance professional to determine the proper disposal of any quantity of unused reagents. Empty reagent containers may be disposed of as general trash after removing all chemical name and warning labels, or may be containerized and disposed of offsite.
- Spent water treatment media (e.g., carbon, resin) should be containerized and disposed of offsite.

If the IDW is containerized and is classified as nonhazardous, the following procedures will apply:

- Place the nonhazardous IDW in DOT-authorized containers (55-gallon drum, roll-off container, or temporary storage tank). Before placing IDW in the containers, ensure that the containers are in good condition and will not leak.
- Drums used as containers must remain closed except when adding, sampling, or inspecting the waste. The drums cannot be used as a work surface once waste is put in the container.
- Mark the container with the appropriate waterproof, self-adhesive nonhazardous waste label. The label must include a description of the contents of the container (e.g., soil cuttings, purge water) and the generator name (the client or the facility, never the company). **Field personnel must consult the project compliance professional for help in properly completing the labels.**
- Complete the IDW Log (Figure 1) before leaving the site. Present one copy of the log to the site contact and the original to the project manager.
- The IDW containers must be properly closed, wiped clean, and stored in a secure onsite location.

HAZARDOUS WASTE MANAGEMENT

If site data or generator knowledge indicates that the IDW is RCRA hazardous, the following procedures will apply:

- Place IDW in DOT-authorized containers (e.g., 55-gallon drum, roll-off container, or temporary storage tank). Before placing IDW in the containers, ensure that the containers are appropriate for the type of IDW generated (e.g., solid in containers authorized for transport of solids), in good condition and will not leak.
- Containers must remain closed except when adding, sampling, or inspecting the material. The containers cannot be used as a work surface once waste is put in the container.

- Mark the container with an appropriate waterproof, self-adhesive hazardous waste label. The label must include the accumulation start date, a description of the contents of the container (e.g., soil cuttings, purge water), the EPA identification number, the generator name (the client or the facility, never the company), and the hazardous waste codes, if known. **Field personnel must consult the project compliance professional for help in properly completing the labels.**
- The IDW containers must be properly closed, wiped clean, and stored in a secure onsite location (i.e., a designated facility hazardous waste storage area) to limit access. At a minimum, place the drums on an impermeable surface (if available) in an area of limited access. If stored outside, cover the containers with a secured tarp at the end of each field day until the containers are picked up for disposal.
- Complete the IDW Log (Figure 1) before leaving the site. Present one copy of the log to the site contact and the original to the project manager.
- If applicable, ensure that weekly inspections are conducted, and the proper inspection forms for documentation are completed during the entire time the waste is stored onsite. **Field personnel must consult the project compliance professional for help to determine if weekly inspections are required.**

If the IDW is presumed to be hazardous and sampling is required to confirm its classification, it must be labeled "Hazardous Waste-Pending Analysis" and sampled for the parameters specified by the project compliance professional or project manager before leaving the site. Any waste confirmation samples must be collected in accordance with the company's SOPs. Treatment, storage, and disposal facilities will usually specify the required analysis for waste profiles.

PCB WASTE MANAGEMENT

If information exists to classify PCB-containing IDW as TSCA-regulated IDW (i.e., PCBs greater than 50 milligrams per kilogram), the following procedures must be implemented:

- Place the PCB-containing IDW in DOT-authorized containers (55-gallon drum, roll-off container, or temporary storage tank). Before placing IDW in the containers, ensure that the containers are in good condition and will not leak.
- Containers must remain closed except when adding, sampling, or inspecting the material. The containers cannot be used as a work surface once waste is put in the container.
- Mark the container with an appropriate waterproof, self-adhesive yellow label with the words "Caution Contains PCBs", the "removed from service" date (the accumulation start date), and a description of the contents of the container (e.g., soil cuttings). Complete the label with the name and phone number of the company personnel to contact in the event of an accident or spill. **Field personnel must consult the project compliance professional for help in properly completing the labels.**
- The IDW containers must be properly closed, wiped clean, and stored in a secure PCB storage area onsite. If a PCB storage area is not available, construct a temporary PCB storage area. Cover the containers with a secured tarp at the end of each field day until the drums are picked up for disposal. Place one yellow 6" x 6" "Caution Contains PCBs" label on the outside of the tarp, and note the "Removed from service date" on the label.
- Complete the IDW Log (Figure 1) before leaving the site. Present one copy of the log to the site contact and the original to the project manager.
- If applicable, inspect the area and the containers for leaks once every 30 days in accordance with TSCA requirements during the entire period the waste is stored onsite. **Field personnel must consult the project compliance professional for help to determine if weekly inspections are also required.**

POST-FIELD IDW MANAGEMENT ACTIVITIES

Field personnel must follow up on the management of the IDW after returning from the field. RCRA hazardous and TSCA-regulated PCB-containing wastes have storage time limits and periodic inspection requirements to remain in compliance with federal, state, or local regulations. Arrangements for proper disposal of wastes must be made within the required time limits and must be consistent with all applicable regulatory requirements, as well as the company's contracting procedures and policies for waste disposal.

INVESTIGATION DERIVED WASTE LOG

Date:_____

Site Information:
Site Name: _____ Site EPA ID #: _____
Site Contact: _____ Site Address: _____
Site Contact Telephone No: _____

Waste Identification:
Type of Waste Generated:
- ☐ Soil Cuttings ☐ PPE ☐ Decontamination Water
- ☐ Groundwater ☐ Storm Water ☐ Drilling Fluids
- ☐ Other (Describe): _____

Field Activities that Generated the Waste:
- ☐ Soil Borings ☐ Well Sampling ☐ Well Installation
- ☐ Decontamination ☐ Excavation ☐ Pumping Tests
- ☐ Other (Describe): _____

Generation Date: _____ ***90-Day Deadline:*** _____
Quantity of Waste Generated and Container Type: _____
_____
Storage Location: _____
Waste Identification:
- ☐ Nonhazardous Waste (pending analysis)
- ☐ Nonhazardous Waste (based on site information or generator knowledge)
- ☐ Hazardous Waste (pending analysis)
- ☐ Hazardous Waste (based on site information or generator knowledge)
- ☐ PCB-containing Waste

If generator knowledge or site information was used for identification, explain: _____
_____
_____
Type of Label Applied to Container: ☐ Nonhazardous ☐ Hazardous ☐ PCB
WSP Information (Note: One copy to site contact - the original copy to project manager)
Personnel/Contact: _____ Project No.:_____
Telephone: _____

Date Removed: _____ Signature: _____

FIELD STANDARD OPERATING PROCEDURE #6

DECONTAMINATION PROCEDURE

The decontamination procedures outlined in this standard operating procedure (SOP) are designed to ensure that all sampling equipment is free from the analytes that could potentially interfere with the sample results. The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

6.1 ACRONYMS AND ABBREVIATIONS

DI	Deionized water
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HASP	Health and safety plan
PPE	Personal protective equipment
QAPP	Quality assurance project plan
SOP	Standard operating procedure

6.2 MATERIALS

- Field book
- PPE
- Polyethylene sheeting and/or garbage bags
- Laboratory-grade non-phosphate detergent[1] (e.g., Luminox® or Liquinox®)
- Cleaning reagents, as needed (e.g., isopropyl alcohol, methanol, hexane, etc.)
- Potable water
- Deionized (DI) water
- Containers (e.g., plastic buckets)
- Nylon brushes
- Aluminum foil
- Spray bottles
- Paper towels
- Pressurized steam cleaner (e.g., steam jenny), as needed
- Decontamination pad, as needed

6.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

[1] Not all laboratory-grade detergents are phosphate free. Be sure to verify the detergent's phosphate content before use.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company's SOPs. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for decontamination and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), and investigation-derived waste management procedures (SOP 5). All decontamination references must be available for consultation in the field, including:

- Company's SOPs
- Applicable state and federal guidelines or procedures
- Manufacturer's manuals
- Project-specific work plan and HASP
- QAPP

6.4 GENERAL PROCEDURES

The cleaning and decontamination procedures described below are designed to ensure that the equipment used for sample collection is free of analytes that could potentially alter the analytical results. These procedures are primarily targeted at reducing the incidence of cross-contamination (i.e., compounds of interest being transferred on the sampling equipment from one sample location or depth to another) and, when properly implemented, provide a methodology for obtaining high quality, representative results. As with all analytical sampling, the effectiveness of the cleaning procedures must be demonstrated with the collection of equipment blanks. The sampling procedures and equipment blank collection frequency are discussed in SOP 4.

6.4.1 EQUIPMENT AND REAGENT SELECTION

It is important for employees to evaluate the expected types of contamination before mobilization to a site. State programs (or the U.S. Environmental Protection Agency [EPA], depending on the site) may require more stringent decontamination procedures than those listed in this SOP, specify the types and grades of various cleaning detergents and reagents (e.g., acids and solvents), or allow the use of phosphate-containing detergents, such as Alconox®. Many of these reagents, such as nitric acid or pesticide-grade hexane, are U.S. Department of Transportation (DOT) hazardous materials and must be shipped using a ground delivery service. These compounds may also require specialized PPE (e.g., eye protection for concentrated acids) or have other special handling or disposal procedures that must be considered before arriving onsite. Decontamination equipment (e.g., spray bottles, brushes, etc.) should be constructed of non-reactive, non-leachable materials (e.g., metal, glass, Teflon®-coated, polyethylene, etc.) which are compatible with the reagents and solvents being used for decontamination.

In specific cases, it may be necessary to steam clean the field equipment before proceeding with the decontamination steps presented in Section 6.5 (e.g., hollow stem augers). Generally, the company's subcontractors are responsible for bringing or building a decontamination pad, if necessary, to contain the spray from a steam jenny. Decontamination pads should be constructed on a level, paved surface (if possible) in an area known or believed to be free of surface contamination, and should be of sufficient size to contain the decontamination water. Equipment that is steam cleaned should be placed on racks or saw horses and not on the floor of the decontamination pad. Decontamination water should be removed from the decontamination pad frequently to minimize the potential for leaks or overflow.

Consult and involve the company's compliance professionals for storage procedures and disposal requirements of solvent rinsate, detergent wastes, and other decontamination materials.

6.4.2 OTHER CONSIDERATIONS

In preparing for decontamination, you should perform the following activities (with all observations and measurements noted in the field book):

- Perform a quick reconnaissance of the site to identify a decontamination (pad) area and evaluate the accessibility to and safety of the location.
- Record a description of the decontamination (pad) area.

Survey the breathing zone around the decontamination area with the appropriate air quality meter(s), as necessary (see HASP), to ensure that the level of PPE is appropriate. When decontaminating equipment, it is important to find a suitable location away from any sources of cross-contamination that could compromise the integrity of the decontamination. As possible, position the decontamination area away from fuel-powered equipment, such as drill rigs or excavators, and upwind of other site activities (e.g., purging, sampling).

6.5 DECONTAMINATION PROCEDURES

The decontamination procedures are based on a nine-step process, which is tailored in the field depending on the samples to be collected. Decontaminate all non-dedicated equipment that contacts the sample directly, including spoons, trowels, pumps, etc., before and between each sample location and sampling interval. Record decontamination procedures in the field book. Disposable, single use items, such as bailers or tubing, do not require decontamination.

The decontamination process includes the following four basic steps:

1. Physical removal of debris
2. Wash with non-phosphate detergent, such as Liquinox®, and nylon brush
3. Potable water rinse
4. Deionized (DI), analyte-free water rinse (distilled water can be used as a substitute)

The first step is to remove as much soil or other debris from the sampling device as possible near the sampling area to limit the spread of potentially-contaminated materials into clean areas of the site.

Cleaning and decontamination should occur at a designated area(s) (decontamination pad) on the site. If gross contamination or an oily film or residue is observed on the equipment, use steam jenny or wash by hand using a brush to remove the particulate matter or surface film. Heavy oils or grease may be removed with paper towels soaked with isopropyl alcohol.

The physical removal is followed by a hand wash using non-phosphate detergent (mixed to the appropriate dilution in potable water) followed by a potable water rinse. If not using a decontamination pad, the most common set-up uses 5-gallon plastic buckets for washing and rinsing, although plastic garbage pails or plastic tubs can also be used. Place containers on polyethylene sheeting to limit spillage of the decontamination fluids.

Be sure to scrub the equipment thoroughly with a nylon bristle brush (or similar) and allow enough submersion time for the non-phosphate detergent to effectively clean the surfaces (a simple dunk of the equipment in the detergent solution is insufficient). If decontaminating submersible pumps, flush both the non-phosphate detergent wash fluid and the potable water rinse through the pump body itself (usually done in separate buckets) to ensure that the internal components are thoroughly cleaned. The internal decontamination of motorized pumps can be accomplished by pumping the non-phosphate detergent wash fluid and the potable water rinse through the pump. Replace the detergent solution and rinse water when it becomes oily or silty.

Place the DI water for the rinse in a small spray bottle or pour over the equipment after the potable water rinse. **Typically, this level of decontamination (i.e., steps 1 through 4) is sufficient.**

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Following Steps 1 through 4, additional decontamination (steps 5 through 9) may be required by the applicable federal or state guidelines, the project-specific work plan or the QAPP. Typically, these decontamination steps are performed when sampling for inorganics using non-motorized equipment. These steps include:

5 10% nitric acid rinse
6 DI water rinse
7 Pesticide-grade solvent rinse (e.g., hexane or isopropyl alcohol)
8 Air dry (solvent must evaporate)
9 DI water rinse

Isopropyl alcohol is the recommended solvent for organic contaminants because it is readily available (at most drug and department stores) and is not a DOT hazardous material. However, other solvents (e.g., hexane and methanol) may be more effective in removing certain contaminants, such as oils or polychlorinated biphenyls, but any waste generated using these solvents must be managed accordingly.

Handle the solvents and acid with care and store unused chemicals in their original, labeled, protective containers when not in use. It is a good idea to transfer small quantities of each solution into labeled, laboratory-grade spray bottles, which offer a convenient and controllable way to rinse the equipment. The equipment can then be rinsed over a 5-gallon plastic bucket or other suitable container placed on plastic sheeting as with the first part of the cleaning process. Nitric acid rinses must be used only on non-carbon steel sampling devices. Do not spray acid into pumps.

6.6 HANDLING DECONTAMINATED EQUIPMENT

Handle any decontaminated equipment using clean gloves to prevent re-contamination. Place the equipment away (preferably upwind) from the decontamination area once the process has been completed on clean plastic sheeting to allow it to air-dry. Once the equipment is dry, protect it from re-contamination by securely wrapping and sealing with aluminum foil (shiny side out) or clean, disposable plastic bags. Plastic bags may be wrapped directly around wet or dry equipment except when the expected contaminants include volatile and extractable organics; under those circumstances, allow the equipment to completely dry or wrap it in aluminum foil.

All sampling equipment must be decontaminated at the end of the investigation (i.e., prior to departure from the site). Label each piece of equipment with the date of decontamination, the initials of personnel performing the decontamination, and the type of decontamination solution(s) used. Containerize all solvent rinsate, detergent wastes, and other disposable decontamination materials in DOT-compliant containers in accordance with SOP 5 or the project-specific work plan. Dispose of all wastes in conformance with the project-specific work plan and applicable regulations.

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FIELD STANDARD OPERATING PROCEDURE #8

AIR QUALITY MONITORING EQUIPMENT PROCEDURE

The procedures outlined in this Standard Operating Procedure (SOP) are designed to ensure that direct-reading air quality monitoring equipment is calibrated and used properly. Specifically, this SOP addresses the short-term or discrete-measurement use of portable direct-reading air quality monitoring equipment for the rapid collection of organic vapor, flammable or explosive atmospheres, carbon dioxide, and dust/aerosol measurements. The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

8.1 ACRONYMS AND ABBREVIATIONS

CGI	Combustible gas indicator
°F	Fahrenheit
FID	Flame ionization detector
HASP	Health and safety plan
IDW	Investigation-derived waste
PID	Photoionization detector
PPE	Personal protective equipment
QAPP	Quality Assurance Project Plan
SOP	Standard operating procedure

8.2 MATERIALS

- Field book
- PPE
- Direct-read air monitoring equipment, as needed
- Calibration reagents or gases, as appropriate
- Decontamination supplies

8.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company's SOPs. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for preparing air quality monitoring equipment for use and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), investigation derived waste (IDW)

management procedures (SOP 5), and equipment decontamination (SOP 6). This SOP does not cover the selection of air quality monitoring equipment, nor does it cover air quality monitoring equipment-specific calibration or use instructions. These topics require a significant amount of planning and are more appropriately addressed in a project-specific work plan. Be sure to review the project-specific work plan or Quality Assurance Project Plan (QAPP) and any applicable state and federal guidelines or calibration procedures. The sampler should be familiar with the use and calibration of all sampling and monitoring equipment. All sampling references must be available for consultation in the field, including:

- Company's SOPs
- Applicable state and federal guidelines or sampling procedures
- Manufacturer's manuals
- Project-specific work plan, HASP, and QAPP

8.4 GENERAL EQUIPMENT HANDLING AND MANAGEMENT PROCEDURES

Single- or multi-parameter air quality meters bundled in a single housing unit. These types of units offer a convenient, easily portable device that is capable of measuring the parameters of concern (e.g., organic vapors, carbon monoxide, dust) during a typical sampling event for field screening and health and safety purposes. Individual parameter air quality meters are available and, in some cases, offer a higher degree of accuracy; however, they are typically relegated to specialty use because most tasks require multi-parameter monitoring.

Field personnel must consult their assigned compliance professionals for assistance in proper use, storage, and disposal of all calibration reagents and gases.

The manufacturer's recommendations and instructions vary from one instrument to the next; however, all types of air quality monitoring equipment share common handling and management procedures designed to ensure the integrity of the measurements collected. Based on these procedures, the user should:

- Transport the air quality monitoring equipment in a padded case that is designed to protect the equipment.
- Follow the manufacturer's instructions for assembly, operation, calibration, and maintenance specific to your equipment. The manufacturer's instructions should be followed explicitly in order to obtain accurate results.
- Ensure that all equipment is in proper working condition, not damaged, and that batteries are properly charged before using the equipment for field testing measurements.
- Protect instruments that are sensitive to static electricity.
- Clean the equipment using only the manufacturer's recommended solutions.
- Record manufacturer name and model number for each instrument used in the field book.
- Calibrate the instrument in the field, as close to the time of use as possible, and repeat at the frequency suggested by the manufacturer.
- Protect the instrument from direct sunlight, precipitation, and extremely hot or cold temperatures (e.g., do not store in vehicle).
- Store cables only after they are clean, dry, and neatly coiled – do not bend or crimp cables.
- Attach any provided storage caps and protect cables from abrasion or unnecessary tension when in use.
- Decontaminate air quality monitoring equipment with a small, nonabrasive brush, cotton swab or cloth (unless otherwise instructed by the manufacturer).

8.5 COMMON DIRECT-READ MONITORING DEVICES

The table below provides a summary of common direct-read air monitoring instruments used by company personnel. Note that the final selection of air monitoring equipment must be based on the technical and health and safety requirements of each project and more than one instrument may be needed.

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INSTRUMENTS	PARAMETER MONITORED	APPLICATION	DETECTION METHOD	LIMITATIONS
Colorimetric Tubes	Organic and inorganic gases and vapors	Provide semi-quantitative concentrations of individual gases and vapors	Reaction with the indicator chemical in the tube produces a stain where length of color change is proportional to the compound's concentration	— Compound-specific (i.e., a specific tube must be used for each compound being measured) — Accuracy is limited (usually to a specific range of concentrations) — Results are affected by humidity and multi-chemical interference
Combustible Gas Indicator (CGI)	Combustible gases and vapors	Measures concentrations of combustible gases and vapors	A filament is heated by burning the combustible gas or vapor and the increase in heat is measured	— Accuracy depends on the difference between the calibration and sampling temperatures — Sensitivity is a function of the differences in the chemical and physical properties between the calibration gas the gas being sampled — The filament can be damage by certain compounds — Does not produce a valid reading under oxygen-deficient conditions
Flame Ionization Detector (FID)	Many organic gases and vapors	Measures total concentration of many organic gases and vapors	Gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present; a total concentration is provided	— Does not detect inorganic gases and vapors or some synthetics — Compound-specific sensitivity — Should not be used below 40°F (degrees Fahrenheit) — Does not produce compound-specific results — Does not produce a valid reading under oxygen-deficient conditions — Readings must be reported relative to the calibration standard used
Photoionization Detector (PID)	Many organic and some inorganic gases and vapors	Measures total concentrations of many organic and some inorganic gases and vapors.	Ionizes molecules using ultraviolet radiation. Produces a current that is proportional to the number of ions; a total concentration is provided	— Does not detect methane — Does not detect a compound if the probe used has a lower ionization energy (electron volt or eV) than the compound's ionization potential — Responses may change when gases are mixed — Does not produce compound–specific results — Other voltage sources may interfere with the operation of the instrument — Readings must be reported relative to the calibration standard used — Instrument response is affected by high humidity
Dust/Aerosol Monitor	Dust, smoke, fumes, and mists	Measures total concentration of airborne particulates	Light scattering laser photometers	— Does not produce compound-specific results

8.6 CALIBRATION PROCEDURES

Air quality monitoring equipment must be inspected and calibrated before use. Consult the manufacturer's guidelines before beginning the calibration process and contact the manufacturer's technical support if problems or questions arise.

Conduct the following procedures to ensure proper testing and calibration and record observations in the field book:

- Inspect the intakes and sensors to be sure that they are clean, installed properly and are not damaged before calibrating and using air quality monitoring equipment in the field.
- Complete field calibration in an area sheltered from wind, dust, chemical gases or vapors, and temperature/sunlight fluctuations, such as inside a room or vehicle in which the ambient temperature of the calibration standards is maintained at >40° Fahrenheit (oF) and < 100°F.
- Record the brand, concentration, lot numbers and expiration dates of reagents or calibration standards in the field book.
- Handle reagents or gases in a manner that prevents their dilution or contamination. Do not reuse or use expired reagents or gases; ensure that reagents or gases are stored securely.
- Ensure that the air quality monitoring equipment has been set to display or record the appropriate measurement unit, as available.
- Calibration frequency is dependent on project specifications, instrument performance, and manufacturer's recommendations; repeat the calibration procedures as directed.
- Document the time, date, and calibration status for each instrument.
- If calibration fails to meet criteria, follow the manufacturer's instructions for corrective action to adjust instrument performance and note any indication of a substandard calibration.
- If the instrument does not start up, meet the requirements above, or calibrate properly, the instrument should not be used.

8.7 EQUIPMENT USE PROCEDURES

Use the monitoring equipment to complete the field measurement procedures directed in the project-specific work plan, HASP, or QAPP after each calibration process is complete. When using the device, the user should:

- Charge instrument batteries per the manufacturer's instructions, as necessary.
- Record background measurements before commencement of any field activities.
- Position the probe assembly in the area to be monitored.
- Do not immerse the probe intake in water or soil and minimize direct exposure to excessive moisture (humidity), dirt or contamination.
- If continuous monitoring is required, follow the manufacturer's instructions for performing continuous data logging events.

Monitoring should be performed at regular intervals as specified in the work plan, QAPP, and/or HASP. Record all measurements in the field book or on field forms and note any conditions that may affect the quality of the data (e.g., changes in weather or background conditions).

8.8 CLOSING NOTES

Once field activities are complete, secure the site in accordance with the project-specific work plan. Decontaminate all equipment prior to departure and properly manage all PPE and IDW in conformance with applicable regulations.

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APPENDIX

C HEAT AND COLD STRESS MONITORING AND PREVENTION

APPENDIX

Heat Stress and Heat Stress Monitoring

Heat is one of the most common (and potentially serious) illnesses at hazardous waste sites where PPE is worn; therefore, regular monitoring and other preventive precautions are vital. Shelter from the sun will be provided during rest periods. Below is a list of the signs and symptoms of heat stress. Initial work schedules will be approximately 90 minutes of work followed by 15 minutes of rest. Work intervals will be adjusted to shorter periods based on the assessment of the SHSC Monitoring for heat stress will be conducted by visual observation by the individual team members.

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 caused by cardiovascular insufficiency or dehydration. Signs and symptoms include:

— pale, cool, moist skin
— heavy sweating
— dizziness
— nausea
— fainting

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 and death occur. Competent medical help must be obtained. Signs and symptoms include:

— red, hot, usually dry skin
— lack of or reduced perspiration
— nausea
— dizziness and confusion
— strong, rapid pulse
— coma

First-aid remedies for heat stress and heat stroke include removing the worker to a cool place, providing cool water or a commercial sport drink, loosening tight clothing, and calling for an ambulance if victim vomits or starts to lose consciousness.

Cold Stress Prevention

The types of cold-related stress are frostbite, hypothermia, and immersion or trench foot. Personnel performing field tasks in the winter months should be aware of the signs and symptoms of cold-related stress so they can take precautionary measures to avoid cold-induced injury and illness. The following is a brief synopsis of each type of cold-related stress.

Frostbite

Frostbite results when cells are cooled until ice crystals form inside them. Most injuries from frostbite are localized to the exposed part of the body.

— First degree frostbite or frostnip usually strikes the tips of fingers, toes, ears, nose, and chin or cheeks. It is usually painless, and the victim is often unaware of it. The skin turns pale or white from first degree frostbite.

— Second degree frostbite can occur in skin and its underlying tissue. The skin becomes firm and white, waxy, or translucent. As the third injured areas warm, it will become numb, and then will turn blue or purple and swell. The superficial capillaries have been injured, and edema fluid will leak out into the tissue. Stinging and burning pain and superficial blisters may develop. The throbbing, aching, and burning may last for some weeks, and the body part may become permanently red and be extremely sensitive if again exposed to the cold.
— Third degree frostbite involves freezing not only the skin and subcutaneous tissue but even muscle and bone. This serious injury usually involves the hands and feet. The tissues are cold, pale, and frozen to the touch. The injured area usually turns purple or blue and is extremely painful after thawing. Large blisters and tissue death (gangrene) may occur within the first day or two.

Hypothermia

Generalized, severe, progressive body cooling is known as systemic hypothermia. This may occur at outside temperatures above freezing as well as below freezing. It occurs when the core temperature of the body falls below 95°F (35°C) and results when the body temperature controlling mechanism is overwhelmed. At 96.8°F, the body attempts to compensate for the cold. As core temperatures fall below 95°F, the body is unable to rewarm itself without assistance because of the failure of the temperature control system.

Hypothermia may be of acute duration if someone is suddenly immersed in cold water. Subacute hypothermia may occur in otherwise healthy people, such as skiers, mountain climbers, or lost hunters, subject to prolonged cold exposure and physical exertion. Chronic hypothermia may occur in old people or those who are ill.

Hypothermia may be mild to moderate, when the core temperature is between 81°F and 95°F and the patient is conscious, or it may be severe, when the core temperature is below 80°F and the patient is unconscious.

The symptoms of hypothermia depend on the core temperature and become progressively more severe as the core temperature drops. Between 95°F and 98.6°F, the first symptom is shivering, a subconscious attempt of the body to generate more heat through muscular action. In addition, certain semiconscious activities occur, such as stamping the foot and dancing up and down. Below 95°F, difficulty in speaking, lack of coordination, stumbling, falling, and an inability to use the hands occur. It is at this point that the loss of temperature control occurs and the body is unable to rewarm itself. Below 90°F, shivering decreases and the muscles become progressively rigid. Below 85°F, the victim becomes irrational and may fall into a coma. The pulse and respiration slow. Below 80°F, unconsciousness occurs. The pulse is weaker, and cardiac arrhythmia may be noted. Below 78°F, the respiratory and cardiovascular centers fail, with resulting pulmonary edema and ventricular fibrillation and then cardiac standstill. Ventricular fibrillation is the usual cause of death in these victims.

Even without a thermometer, the level of hypothermia may be noted by observing the victim's mental state. With a few degrees' drop in core temperature, the victim may become withdrawn, discouraged, or mildly depressed. As the temperature drops a few degrees more, to 94°F or below, the victim may become indecisive, confused, or disoriented and may make incorrect decisions. Below 86°F, sleepiness, lethargy, and confusion are obvious. These progressively become more sever until coma occurs. The comatose state, if allowed to continue, results in death. The stages of hypothermia may progress rapidly after the victim's temperature falls below 90°F.

Trench Foot

Trench foot or immersion foot occurs from the wet cooling of an extremity over hours or days at a temperature just above freezing while remaining relatively immobile. It used to been commonly in shipwrecked sailors or soldiers forced to remain in trenches for days at a time. The extremity is cold, swollen, waxy, mottled, and may be numb.

Preventive Work Guidelines

13 Exposure to cold will be terminated immediately when severe shivering becomes evident.
14 When air temperature falls below 30°F, dry bulb temperature and wind speed will be measured periodically, and the wind chill factor will be calculated. (Weather radios are an adequate substitute.)
15 All work except for emergencies will be terminated when the wind chill is below -18°F.

16 Metal tool handles will be covered with thermal insulating material at temperatures below 30°F.
17 When work is performed continuously in the cold at a wind chill of below 20°F, heated shelter will be made available. A vehicle can be used for shelter if it is kept idling with the heater on.
18 Work will be arranged in such a way that sitting or standing for long periods of time is minimized.
19 Keep warm, dry, and keep moving, but do not become overheated while working in the cold. Exercise fingers and toes.

APPENDIX

D JOB HAZARD ANALYSIS

HAZARD ANALYSIS

DATE PREPARED: 01/02/2018 **PREPARED BY: Laura Tobin**

OPERATION: Soil removal, geotechnical drilling, soil excavation, soil sampling, groundwater investigation, hazardous building materials assessment

STEP BY STEP PLAN:

1. Mobilize/Demobilize
2. Set up traffic control (if necessary)
3. Load and unload equipment
4. Tailgate meeting (daily)
5. Locate and mark drilling location
6. Clear drilling location for utilities
7. Remove and containerize upper 1 foot of near surface soil, as necessary
8. Park the drill rig on final location
9. Raise drilling mast
10. Begin drilling
11. Begin excavation
12. Collect, screen, and describe soil sample
13.Collect soil samples for laboratory analysis
14. Advance groundwater sampler/install temporary well, if required
15.Collect groundwater sample for laboratory analysis
16. Backfill borehole
17. Decontamination
18. Restoration
19. Manage generated wastes (soil and groundwater)

Access Identification

Location	Type

Ergonomic risks

Lifting	☒
Repetitive Motion	☒
Vibration	☒
Awkward Position	☒

Strategic Risks	Evident Risk	Needs Special Planning
Equipment	☒	☐
Exposure to Falls	☒	☐
Confined Space	☐	☐
Traffic	☒	☐
Trenching / Excavation	☒	☐
Lock-Out / Tag-out	☐	☐
MSDS Attached	☐	☐
Utilities	☒	☐
Electrical	☒	☐
Critical Lift Plan	☐	☐
On the Spot Lift Plan	☐	☐
Steel Erection	☐	☐
Night Work	☐	☐
Falsework / Shoring	☐	☐
Other Safety risks	☐	☐
	☐	☐
	☐	☐
	☐	☐

Unique PPE	Required
Cutting Goggles	☐
Face Shield	☐
Leather/Kevlar Chaps	☐
Respiratory Protection	☐
Toe/Foot Guards	☐
Ear Plugs/Muffs	☒
Life Vest/PFD	☐
Welding Hood	☐
Welding Leathers	☐
Other PPE:	☐
Other PPE:	☐
Other PPE:	☐
Other PPE:	☐
Other PPE:	☐
	☐
Superintendent	

Prepared and reviewed by:	
Name	Signature
Foreman	

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	Step 1: Mobilization/Demobilization	Step 2:Set up traffic control	Step 3:Load/Unload Equipment
WHAT IS THE WORST THAT COULD HAPPEN?	Traffic accidents Vehicle breakdown	Struck by vehicles Traffic accidents	Struck by vehicles Traffic accidents
PREVENTION PLAN (Focus on Behaviors)	Inspect vehicles Stay alert Obey traffic laws Don't drive tired Reduce speed in Inclement weather Park nonessential Vehicles outside Work zone	Use caution in traffic Areas Use a spotter Wear high visibility Vest Work during daylight hours	Use caution in traffic Areas Use a spotter Wear high visibility Vest Work during daylight hours
HOW ARE YOU MOST LIKELY TO GET HURT?	Slips, trips, falls	Strains and sprains Slips, trips, falls Pinch points	Mechanical (pinch Points) Strains and sprains Falls (slips, trips)
PREVENTION PLAN (Focus on Behaviors)	Be alert	Wear proper PPE Use proper lifting Techniques	Wear proper PPE Proper lifting techniques Use proper lifting Techniques
OTHER RISKS TO BE AWARE OF?		Sunlight (UV) exposure Hot/cold stress Inclement weather Biohazards	Sunlight (UV) exposure Hot/cold stress Inclement weather Biohazards Excessive noise
PREVENTION PLAN (Focus on Behaviors)		Use sunscreen Wear proper clothing Hydrate Inspect spray	Use sunscreen Wear proper clothing Hydrate Inspect spray Wear proper PPE

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	Step 4: Tailgate meeting (daily)		Step 5:Locate and mark drilling locations		Step 6:Clear drilling locations for utilities	
WHAT IS THE WORST THAT COULD HAPPEN?	Slips, trips, falls		Struck by vehicles	Inclement weather	Struck by vehicles	Inclement weather
	Poor visibility					
	Inclement weather					
PREVENTION PLAN (Focus on Behaviors)	Use caution		Be alert	Wear proper PPE	Be alert	
	Wear proper PPE		Wear high visibility vest		Wear proper PPE	
	Work during day-Light hours		Work during day-Light hours		Wear high visibility vest	
					Work during day-Light hours	
HOW ARE YOU MOST LIKELY TO GET HURT?	Slips, trips, falls		Slips, trips, falls	Strains and sprains	Slips, trips, falls	
					Strains and sprains	
PREVENTION PLAN (Focus on Behaviors)	Be alert		Be alert		Be alert	
	Housekeeping				Use caution	
OTHER RISKS TO BE AWARE OF?	Sunlight (UV) exposure	Hot/cold stress	Sunlight (UV) exposure	Hot/cold stress	Sunlight (UV) exposure	Hot/cold stress
	Inclement weather	Biohazards	Inclement weather	Biohazards	Inclement weather	Biohazards
PREVENTION PLAN (Focus on Behaviors)	Use sunscreen	Wear proper clothing	Use sunscreen	Wear proper clothing	Use sunscreen	Wear proper clothing
	Hydrate	Inspect spray	Hydrate	Inspect spray	Hydrate	Inspect spray

	Step 7: Remove and containerize upper 1 foot of near surface soil, as necessary		Step 8:Park the drill rig on final location		Step 9:Raise drill mast	
WHAT IS THE WORST THAT COULD HAPPEN?	Struck by vehicles/ equipment	Pinch point	Struck by vehicles		Struck by equipment	
					Contact with overhead Power lines	
PREVENTION PLAN (Focus on Behaviors)			Use spotter		Be alert	
			Wear high visibility vest		Maintain safe distance From overhead power lines	
HOW ARE YOU MOST LIKELY TO GET HURT?	Slips, trips, falls		Slips, trips falls		Slips, trips, falls	
	Strains and sprains					
	Chemical exposure					
PREVENTION PLAN (Focus on Behaviors)	Be alert	Use caution	Be alert	Use caution	Be alert	Use caution
	Housekeeping	Use proper lifting techniques				
	Wear proper PPE	Conduct air monitoring				
OTHER RISKS TO BE AWARE OF?	Sunlight (UV) exposure	Hot/cold stress	Sunlight (UV) exposure	Hot/cold stress	Sunlight (UV) exposure	Hot/cold stress
	Inclement weather	Biohazards	Inclement weather	Biohazards	Inclement weather	Biohazards
			High noise levels		High noise levels	
PREVENTION PLAN (Focus on Behaviors)	Use sunscreen	Wear proper clothing	Use sunscreen	Wear proper clothing	Use sunscreen	Wear proper clothing
	Hydrate	Inspect spray	Hydrate	Inspect spray	Hydrate	Inspect spray
			Wear proper PPE		Wear proper PPE	

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	Step 10: Begin drilling		Step 11: Begin Excavation		Step 12: Collect, screen and describe Soil samples	
WHAT IS THE WORST THAT COULD HAPPEN?	Ignition of explosive Gases		Ignition of explosive Gases	Cave ins	Pinch points	Cuts, abrasions
	Impacts with equipment	Hit underground utilities	Struck by vehicles	Hit underground utilities	Struck by equipment	
PREVENTION PLAN (Focus on Behaviors)	Conduct air monitoring		Conduct air Monitoring	Wear high Visibility vest	Wear proper PPE	Be alert
	Wear proper PPE		Stay a safe distance Away from excavation	Proper shoring/ Benching techniques		
	Clear utilities		Clear utilities	Do not enter excavation		
			Use barricades			
HOW ARE YOU MOST LIKELY TO GET HURT?	Strains and sprains		Strains and sprains		Slips, trips, falls	
	Slips, trips, falls		Slips, trips, falls			
	Pinch points					
PREVENTION PLAN (Focus on Behaviors)	Be alert	Use caution	Be alert	Use caution	Be alert	Use caution
	Wear proper PPE		Wear proper PPE			
OTHER RISKS TO BE AWARE OF?	Exposure to organic vapors	Loud noise	Exposure to organic vapors	Loud noise	Exposure to organic Vapors	
	Sunlight (UV) exposure	Hot/cold stress	Sunlight (UV) exposure	Hot/cold stress	Sunlight (UV) exposure	Hot/cold stress
	Inclement weather	Biohazards	Inclement weather	Biohazards	Inclement weather	Biohazards
	Exposure to asphyxiants		Exposure to asphyxiants			
PREVENTION PLAN (Focus on Behaviors)	Air monitoring		Air monitoring		Air monitoring	
	Wear PPE		Wear PPE		Wear PPE	
	Use sunscreen	Wear proper clothing	Use sunscreen	Wear proper clothing	Use sunscreen	Wear proper clothing
	Hydrate	Inspect spray	Hydrate	Inspect spray	Hydrate	Inspect spray

	Step 13: Collect soil samples for laboratory Analysis		Step 14: Advance groundwater sampler/install temporary well, if required		Step 15: Collect groundwater sample for laboratory analysis	
WHAT IS THE WORST THAT COULD HAPPEN?	Dermal exposure to contaminants	Inhalation hazards	Explosive gases	Struck by equipment	Dermal exposure to contaminants	Inhalation hazards
	Cuts, abrasions		Exposure to asphyxiants			
PREVENTION PLAN (Focus on Behaviors)	Wear proper PPE		Conduct air monitoring	Be alert	Wear proper PPE	
	Use caution		Wear proper PPE	Use caution	Use caution	
HOW ARE YOU MOST LIKELY TO GET HURT?	Slips, trips, falls	Strains and sprains	Strains and sprains	Slips, trips, falls	Slips, trips, falls	
PREVENTION PLAN (Focus on Behaviors)	Be alert	Use caution	Use proper lifting Techniques	Be alert	Be alert	
OTHER RISKS TO BE AWARE OF?	Sunlight (UV) exposure	Hot/cold stress	Dermal exposure to contaminants	Inhalation of Organic compounds	Sunlight (UV) exposure	Hot/cold stress
	Inclement weather		Sunlight (UV) exposure	Hot/cold stress	Inclement weather	
			Inclement weather			
PREVENTION PLAN (Focus on Behaviors)	Use sunscreen	Wear proper clothing	Wear PPE	Wear proper clothing	Use sunscreen	Wear proper clothing
	Hydrate		Use sunscreen	Wear proper clothing	Hydrate	
			Hydrate			

	Step 16: Backfill borehole		Step 17: Decontamination		Step 18: Restoration
WHAT IS THE	Explosive gases	Exposure to asphysiants	Impacts from equipment	Electrical shock	Vehicle or equipment impacts

WORST THAT COULD HAPPEN?			Exposure to high pressure			
PREVENTION PLAN (Focus on Behaviors)	Conduct air monitoring Wear proper PPE		Proper equipment Grounding 'Wear proper PPE	Be alert Inspect Equipment	Be alert	
HOW ARE YOU MOST LIKELY TO GET HURT?	Strains and sprains Inhalation hazards	Slips, trips, falls	Inhalation hazards Strains and sprains	Slips, trips, falls Dermal exposure To contaminants	Pinch points Slips, trips, falls	Strains and sprains
PREVENTION PLAN (Focus on Behaviors)	Use proper lifting Techniques Wear proper PPE	Be alert	Use proper lifting Techniques Wear proper PPE	Be alert	Use proper lifting Techniques Wear proper PPE	Be alert
OTHER RISKS TO BE AWARE OF?	Sunlight (UV) exposure Inclement weather	Hot/cold stress Biohazards	Sunlight (UV) exposure Inclement weather	Hot/cold stress Biohazards	Sunlight (UV) exposure Inclement weather	Hot/cold stress Biohazards
PREVENTION PLAN (Focus on Behaviors)	Use sunscreen Hydrate Be alert	Wear proper clothing Inspect spray	Use sunscreen Hydrate Be alert	Wear proper clothing Inspect spray	Use sunscreen Hydrate Be alert	Wear proper clothing Inspect spray

	Step 19: Manage generated wastes (soil and groundwater)		
WHAT IS THE WORST THAT	Struck by vehicles and equipment		

COULD HAPPEN?				
PREVENTION PLAN (Focus on Behaviors)	Be alert	Wear high visibility vests		
	Use a spotter			
HOW ARE YOU MOST LIKELY TO GET HURT?	Strains and sprains	Pinch points		
	Slips, trips, falls			
PREVENTION PLAN (Focus on Behaviors)	Use proper lifting Techniques	Be alert		
	Wear proper PPE			
OTHER RISKS TO BE AWARE OF?	Sunlight (UV) exposure	Hot/cold stress		
	Inclement weather	Biohazards		
PREVENTION PLAN (Focus on Behaviors)	Use sunscreen	Wear proper clothing		
	Hydrate	Inspect spray		

FALL PROTECTION WORK PLAN

Operation _____ Date _____

Identify hazards in work area:

Check Method of fall prevention/protection to be used:

- ☐ Standard Guardrail (top, mid and toeboard)
- ☐ Anchorage point of 5000lb load/person
- ☐ Boom lift (designated operator required)
- ☐ Other (Specify)
- ☐ Horizontal lifeline
- ☐ Vertical lifeline
- ☐ Retractable

Check equipment to be used:

- ☐ Full body harness
- ☐ Positioning lanyard
- ☐ Rope/Cable grab
- ☐ Retractable Lanyard

Describe procedure for assembly, maintenance, inspection and disassembly of system:

Describe procedure for handling and securing tools, equipment and overhead protection for work areas below: (ex: toe boards, tool lanyards, etc.)

Describe method for prompt, safe retrieval:

Sketch of system: Use back of page if necessary.

I certify that I understand the hazards of this operation and have received necessary training associated with this operation.

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APPENDIX

E NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

Arsenic (inorganic compounds, as As)

Synonyms & Trade Names

Arsenia, Arsenic metal [Note: OSHA considers "Inorganic Arsenic" to mean copper acetoarsenite and all inorganic compounds containing arsenic except ARSINE.]

CAS No.

7440-38-2 (metal)

RTECS No.

CG0525000 (metal)

DOT ID & Guide

1558 152(metal)
1562 152(dust)

Formula

As (metal)

Conversion

IDLH

Ca [5 mg/m^3 (as As)]
See: 7440382

Exposure Limits

NIOSH REL

Ca C 0.002 mg/m^3 [15-minute] See Appendix A (nengapdxa.html)

OSHA PEL

[1910.1018] TWA 0.010 mg/m^3

Measurement Methods

NIOSH 7300 , 7301 , 7303 , 7900 , 9102 ;
OSHA ID105
See: NMAM or OSHA Methods

Physical Description
Metal: Silver-gray or tin-white, brittle, odorless solid.

Molecular Weight
74.9

Boiling Point
Sublimes

Melting Point
1135°F (Sublimes)

Solubility
Insoluble

Vapor Pressure
0 mmHg (approx)

Ionization Potential
NA

Specific Gravity
5.73 (metal)

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

Arsenic (inorganic compounds, as As)

Synonyms & Trade Names

Arsenia, Arsenic metal [Note: OSHA considers "Inorganic Arsenic" to mean copper acetoarsenite and all inorganic compounds containing arsenic except ARSINE.]

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Formula

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Conversion

IDLH

Ca [5 mg/m^3 (as As)]
See: 7440382

Exposure Limits

NIOSH REL

Ca C 0.002 mg/m^3 [15-minute] See Appendix A (nengapdxa.html)

OSHA PEL

[1910.1018] TWA 0.010 mg/m^3

Measurement Methods

NIOSH 7300 , 7301 , 7303 , 7900 , 9102 ;
OSHA ID105
See: NMAM or OSHA Methods

Physical Description
Metal: Silver-gray or tin-white, brittle, odorless solid.

Molecular Weight
74.9

Boiling Point
Sublimes

Melting Point
1135°F (Sublimes)

Solubility
Insoluble

Vapor Pressure
0 mmHg (approx)

Ionization Potential
NA

Specific Gravity
5.73 (metal)

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

Asbestos

Synonyms & Trade Names

Actinolite, Actinolite asbestos, Amosite (cummingtonite-grunerite), Anthophyllite, Anthophyllite asbestos, Chrysotile, Crocidolite (Riebeckite), Tremolite, Tremolite asbestos

CAS No.

1332-21-4

RTECS No.

CI6475000

DOT ID & Guide

2212 171(blue, brown)
2590 171(white)

Formula

Hydrated mineral silicates

Conversion

IDLH

Ca [N.D.]
See: IDLH INDEX

Exposure Limits

NIOSH REL

Ca See Appendix A (nengapdxa.html) See Appendix C (nengapdxc.html)

OSHA PEL

[1910.1001] [1926.1101] See Appendix C (nengapdxc.html)

Measurement Methods

NIOSH 7400 , 7402 ;
OSHA ID160 , ID191
See: NMAM or OSHA Methods

Physical Description
White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids.

Molecular Weight
Varies

Boiling Point
Decomposes

Melting Point
1112°F (Decomposes)

Solubility
Insoluble

Vapor Pressure
0 mmHg (approx)

Ionization Potential
NA

Specific Gravity
?

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

Benzene

Synonyms & Trade Names
Benzol, Phenyl hydride

CAS No.
71-43-2

RTECS No.
CY1400000

DOT ID & Guide
1114 130

Formula
C_6H_6

Conversion
1 ppm = 3.19 mg/m^3

IDLH
Ca [500 ppm]
See: 71432

Exposure Limits
NIOSH REL
Ca TWA 0.1 ppm ST 1 ppm See Appendix A (nengapdxa.html)
OSHA PEL
[1910.1028] TWA 1 ppm ST 5 ppm See Appendix F (nengapdxf.html)

Measurement Methods
NIOSH 1500 , 1501 , 3700 , 3800 ;
OSHA 12 , 1005
See: NMAM or OSHA Methods

Physical Description
Colorless to light-yellow liquid with an aromatic odor. [Note: A solid below 42°F.]

Molecular Weight
78.1

Boiling Point
176°F

Freezing Point
42°F

Solubility
0.07%

Vapor Pressure
75 mmHg

Ionization Potential
9.24 eV

Specific Gravity
0.88

Flash Point
12°F

Upper Exposive Limit
7.8%

Lower Explosive Limit
1.2%

Cadmium dust (as Cd)

Synonyms & Trade Names
Cadmium metal

CAS No.
7440-43-9 (metal)

RTECS No.
EU9800000 (metal)

DOT ID & Guide
2570 154(cadmium compound)

Formula
Cd (metal)

Conversion

IDLH
Ca [9 mg/m^3 (as Cd)]
See: 7440439

Exposure Limits
NIOSH REL
Ca See Appendix A (nengapdxa.html) [*Note: The REL applies to all Cadmium compounds (as Cd).]
OSHA PEL
[1910.1027] TWA 0.005 mg/m^3 [*Note: The PEL applies to all Cadmium compounds (as Cd).]

Measurement Methods
NIOSH 7048 , 7300 , 7301 , 7303 , 9102 ;
OSHA ID121 , ID125G , ID189 , ID206
See: NMAM or OSHA Methods

Physical Description
Metal: Silver-white, blue-tinged lustrous, odorless solid.

Molecular Weight
112.4

Boiling Point
1409°F

Melting Point
610°F

Solubility
Insoluble

Vapor Pressure
0 mmHg (approx)

Ionization Potential
NA

Specific Gravity
8.65 (metal)

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

Carbon monoxide

Synonyms & Trade Names
Carbon oxide, Flue gas, Monoxide

CAS No.
630-08-0

RTECS No.
FG3500000

DOT ID & Guide
1016 119
9202 168(cryogenic liquid)

Formula
CO

Conversion
1 ppm = 1.15 mg/m^3

IDLH
1200 ppm
See: 630080

Exposure Limits
NIOSH REL
TWA 35 ppm (40 mg/m^3) C 200 ppm (229 mg/m^3)
OSHA PEL
TWA 50 ppm (55 mg/m^3) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 6604 ;
OSHA ID209 , ID210
See: NMAM or OSHA Methods

Physical Description
Colorless, odorless gas. [Note: Shipped as a nonliquefied or liquefied compressed gas.]

Molecular Weight
28.0

Boiling Point
-313°F

Melting Point
-337°F

Solubility
2%

Vapor Pressure
>35 atm

Ionization Potential
14.01 eV

Flash Point
NA (Gas)

Upper Exposive Limit
74%

Lower Explosive Limit
12.5%

Relative Gas Density
0.97

Chloroform

Synonyms & Trade Names
Methane trichloride, Trichloromethane

CAS No.
67-66-3

RTECS No.
FS9100000

DOT ID & Guide
1888 151

Formula
$CHCl_3$

Conversion
1 ppm = 4.88 mg/m^3

IDLH
Ca [500 ppm]
See: 67663

Exposure Limits
NIOSH REL
Ca ST 2 ppm (9.78 mg/m^3) [60-minute] See Appendix A (nengapdxa.html)
OSHA PEL
C 50 ppm (240 mg/m^3) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1003
See: NMAM or OSHA Methods

Physical Description
Colorless liquid with a pleasant odor.

Molecular Weight
119.4

Boiling Point
143°F

Freezing Point
-82°F

Solubility
(77°F): 0.5%

Vapor Pressure
160 mmHg

Ionization Potential
11.42 eV

Specific Gravity
1.48

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

Coal tar pitch volatiles

Synonyms & Trade Names

Acridine, Anthracene, Benzo(a)pyrene, Chrysene, Coal tar, Phenanthrene, pyrene [Note: NIOSH considers coal tar, coal tar pitch, and creosote to be coal tar products.]

CAS No.

65996-93-2

RTECS No.

GF8655000

DOT ID & Guide

2713 153(acridine)

Formula

Conversion

IDLH

Ca [80 mg/m^3]
See: 65996932

Exposure Limits

NIOSH REL

Ca TWA 0.1 mg/m^3 (cyclohexane-extractable fraction) See Appendix A (nengapdxa.html) See Appendix C (nengapdxc.html)

OSHA PEL

TWA 0.2 mg/m^3 (benzene-soluble fraction) [1910.1002] See Appendix C (nengapdxc.html)

Measurement Methods

OSHA 58
See: NMAM or OSHA Methods

Physical Description

Black or dark-brown amorphous residue.

Molecular Weight

Properties vary depending upon the specific compound.

Ethyl benzene

Synonyms & Trade Names
Ethylbenzol, Phenylethane

CAS No.
100-41-4

RTECS No.
DA0700000

DOT ID & Guide
1175 130

Formula
$CH_3CH_2C_6H_5$

Conversion
1 ppm = 4.34 mg/m^3

IDLH
800 ppm [10%LEL]
See: 100414

Exposure Limits
NIOSH REL
TWA 100 ppm (435 mg/m^3) ST 125 ppm (545 mg/m^3)
OSHA PEL
TWA 100 ppm (435 mg/m^3) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1501 ;
OSHA 7 , 1002
See: NMAM or OSHA Methods

Physical Description
Colorless liquid with an aromatic odor.

Molecular Weight
106.2

Boiling Point
277°F

Freezing Point
-139°F

Solubility
0.01%

Vapor Pressure
7 mmHg

Ionization Potential
8.76 eV

Specific Gravity
0.87

Flash Point
55°F

Upper Exposive Limit
6.7%

Lower Explosive Limit
0.8%

Hydrogen sulfide

Synonyms & Trade Names
Hydrosulfuric acid, Sewer gas, Sulfuretted hydrogen

CAS No.
7783-06-4

RTECS No.
MX1225000

DOT ID & Guide
1053 117

Formula
H_2S

Conversion
1 ppm = 1.40 mg/m^3

IDLH
100 ppm
See: 7783064

Exposure Limits
NIOSH REL
C 10 ppm (15 mg/m^3) [10-minute]
OSHA PEL
C 20 ppm 50 ppm [10-minute maximum peak] See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 6013 ;
OSHA ID141
See: NMAM or OSHA Methods

Physical Description

Colorless gas with a strong odor of rotten eggs. [Note: Sense of smell becomes rapidly fatigued & can NOT be relied upon to warn of the continuous presence of H_2S. Shipped as a liquefied compressed gas.]

Molecular Weight

34.1

Boiling Point

-77°F

Freezing Point

-122°F

Solubility

0.4%

Vapor Pressure

17.6 atm

Ionization Potential

10.46 eV

Flash Point

NA (Gas)

Upper Exposive Limit

44.0%

Lower Explosive Limit

4.0%

Relative Gas Density

1.19

Lead

Synonyms & Trade Names
Lead metal, Plumbum

CAS No.
7439-92-1

RTECS No.
OF7525000

DOT ID & Guide

Formula
Pb

Conversion

IDLH
100 mg/m^3 (as Pb)
See: 7439921

Exposure Limits
NIOSH REL
TWA (8-hour) 0.050 mg/m^3 See Appendix C (nengapdxc.html) [*Note: The REL also applies to other lead compounds (as Pb) -- see Appendix C.]
OSHA PEL
[1910.1025] TWA 0.050 mg/m^3 See Appendix C (nengapdxc.html) [*Note: The PEL also applies to other lead compounds (as Pb) -- see Appendix C.]

Measurement Methods
NIOSH 7082 , 7105 , 7300 , 7301 , 7303 , 7700 , 7701 , 7702 , 9100 , 9102 , 9105 ;
OSHA ID206 , ID121 , ID125G
See: NMAM or OSHA Methods

Physical Description
A heavy, ductile, soft, gray solid.

Molecular Weight
207.2

Boiling Point
3164°F

Melting Point
621°F

Solubility
Insoluble

Vapor Pressure
0 mmHg (approx)

Ionization Potential
NA

Specific Gravity
11.34

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

m-Xylene

Synonyms & Trade Names
1,3-Dimethylbenzene, meta-Xylene, m-Xylol

CAS No.
108-38-3

RTECS No.
ZE2275000

DOT ID & Guide
1307 130

Formula
$C_6H_4(CH_3)_2$

Conversion
1 ppm = 4.34 mg/m^3

IDLH
900 ppm
See: 95476

Exposure Limits
NIOSH REL
TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)
OSHA PEL
TWA 100 ppm (435 mg/m^3) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1501 , 3800 ;
OSHA 1002
See: NMAM or OSHA Methods

Physical Description
Colorless liquid with an aromatic odor.

Molecular Weight
106.2

Boiling Point
282°F

Freezing Point
-54°F

Solubility
Slight

Vapor Pressure
9 mmHg

Ionization Potential
8.56 eV

Specific Gravity
0.86

Flash Point
82°F

Upper Exposive Limit
7.0%

Lower Explosive Limit
1.1%

Naphthalene

Synonyms & Trade Names
Naphthalin, Tar camphor, White tar

CAS No.
91-20-3

RTECS No.
QJ0525000

DOT ID & Guide
1334 133(crude or refined)
2304 133(molten)

Formula
$C_{10}H_8$

Conversion
1 ppm = 5.24 mg/m^3

IDLH
250 ppm
See: 91203

Exposure Limits
NIOSH REL
TWA 10 ppm (50 mg/m^3) ST 15 ppm (75 mg/m^3)
OSHA PEL
TWA 10 ppm (50 mg/m^3) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1501 ;
OSHA 35
See: NMAM or OSHA Methods

Physical Description
Colorless to brown solid with an odor of mothballs. [Note: Shipped as a molten solid.]

Molecular Weight
128.2

Boiling Point
424°F

Melting Point
176°F

Solubility
0.003%

Vapor Pressure
0.08 mmHg

Ionization Potential
8.12 eV

Specific Gravity
1.15

Flash Point
174°F

Upper Exposive Limit
5.9%

Lower Explosive Limit
0.9%

o-Xylene

Synonyms & Trade Names
1,2-Dimethylbenzene, ortho-Xylene, o-Xylol

CAS No.
95-47-6

RTECS No.
ZE2450000

DOT ID & Guide
1307 130

Formula
$C_6H_4(CH_3)_2$

Conversion
1 ppm = 4.34 mg/m^3

IDLH
900 ppm
See: 95476

Exposure Limits
NIOSH REL
TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)
OSHA PEL
TWA 100 ppm (435 mg/m^3) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1501 , 3800 ;
OSHA 1002
See: NMAM or OSHA Methods

Physical Description
Colorless liquid with an aromatic odor.

Molecular Weight
106.2

Boiling Point
292°F

Freezing Point
-13°F

Solubility
0.02%

Vapor Pressure
7 mmHg

Ionization Potential
8.56 eV

Specific Gravity
0.88

Flash Point
90°F

Upper Exposive Limit
6.7%

Lower Explosive Limit
0.9%

Sulfur dioxide

Synonyms & Trade Names
Sulfur oxide, Sulfurous acid anhydride, Sulfurous oxide

CAS No.
7446-09-5

RTECS No.
WS4550000

DOT ID & Guide
1079 125

Formula
SO_2

Conversion
1 ppm = 2.62 mg/m^3

IDLH
100 ppm
See: 7446095

Exposure Limits
NIOSH REL
TWA 2 ppm (5 mg/m^3) ST 5 ppm (13 mg/m^3)
OSHA PEL
TWA 5 ppm (13 mg/m^3) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 3800 , 6004 ;
OSHA ID104 , ID200
See: NMAM or OSHA Methods

Physical Description
Colorless gas with a characteristic, irritating, pungent odor. [Note: A liquid below 14°F. Shipped as a liquefied compressed gas.]

Molecular Weight
64.1

Boiling Point
14°F

Freezing Point
-104°F

Solubility
10%

Vapor Pressure
3.2 atm

Ionization Potential
12.30 eV

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

Relative Gas Density
2.26

Tetrachloroethylene

Synonyms & Trade Names
Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene

CAS No.
127-18-4

RTECS No.
KX3850000

DOT ID & Guide
1897 160

Formula
$Cl_2C{=}CCl_2$

Conversion
1 ppm = 6.78 mg/m^3

IDLH
Ca [150 ppm]
See: 127184

Exposure Limits
NIOSH REL
Ca Minimize workplace exposure concentrations. See Appendix A (nengapdxa.html)
OSHA PEL
TWA 100 ppm
C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm
See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1003 ;
OSHA 1001
See: NMAM or OSHA Methods

Physical Description
Colorless liquid with a mild, chloroform-like odor.

Molecular Weight
165.8

Boiling Point
250°F

Freezing Point
-2°F

Solubility
0.02%

Vapor Pressure
14 mmHg

Ionization Potential
9.32 eV

Specific Gravity
1.62

Flash Point
NA

Upper Exposive Limit
NA

Lower Explosive Limit
NA

Toluene

Synonyms & Trade Names
Methyl benzene, Methyl benzol, Phenyl methane, Toluol

CAS No.
108-88-3

RTECS No.
XS5250000

DOT ID & Guide
1294 130

Formula
$C_6H_5CH_3$

Conversion
1 ppm = 3.77 mg/m^3

IDLH
500 ppm
See: 108883

Exposure Limits
NIOSH REL
TWA 100 ppm (375 mg/m^3) ST 150 ppm (560 mg/m^3)
OSHA PEL
TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1500 , 1501 , 3800 , 4000 ;
OSHA 111
See: NMAM or OSHA Methods

Physical Description
Colorless liquid with a sweet, pungent, benzene-like odor.

Molecular Weight
92.1

Boiling Point
232°F

Freezing Point
-139°F

Solubility
(74°F): 0.07%

Vapor Pressure
21 mmHg

Ionization Potential
8.82 eV

Specific Gravity
0.87

Flash Point
40°F

Upper Exposive Limit
7.1%

Lower Explosive Limit
1.1%

Trichloroethylene

Synonyms & Trade Names
Ethylene trichloride, TCE, Trichloroethene, Trilene

CAS No.
79-01-6

RTECS No.
KX4550000

DOT ID & Guide
1710 160

Formula
$ClCH{=}CCl_2$

Conversion
1 ppm = 5.37 mg/m^3

IDLH
Ca [1000 ppm]
See: 79016

Exposure Limits
NIOSH REL
Ca See Appendix A (nengapdxa.html) See Appendix C (nengapdxc.html)
OSHA PEL
TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours) See Appendix G (nengapdxg.html)

Measurement Methods
NIOSH 1022 , 3800 ;
OSHA 1001
See: NMAM or OSHA Methods

Physical Description
Colorless liquid (unless dyed blue) with a chloroform-like odor.

Molecular Weight
131.4

Boiling Point
189°F

Freezing Point
-99°F

Solubility
0.1%

Vapor Pressure
58 mmHg

Ionization Potential
9.45 eV

Specific Gravity
1.46

Flash Point
?

Upper Exposive Limit
(77°F): 10.5%

Lower Explosive Limit
(77°F): 8%

Vinyl chloride

Synonyms & Trade Names
Chloroethene, Chloroethylene, Ethylene monochloride, Monochloroethene, Monochloroethylene, VC, VCM, Vinyl chloride monomer (VCM)

CAS No.
75-01-4

RTECS No.
KU9625000

DOT ID & Guide
1086 116P(inhibited)

Formula
CH_2=CHCl

Conversion
1 ppm = 2.56 mg/m^3

IDLH
Ca [N.D.]
See: IDLH INDEX

Exposure Limits
NIOSH REL
Ca See Appendix A (nengapdxa.html)
OSHA PEL
[1910.1017] TWA 1 ppm C 5 ppm [15-minute]

Measurement Methods
NIOSH 1007 ;
OSHA 4 , 75
See: NMAM or OSHA Methods

Physical Description
Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations. [Note: Shipped as a liquefied compressed gas.]

Molecular Weight
62.5

Boiling Point
7°F

Freezing Point
-256°F

Solubility
(77°F): 0.1%

Vapor Pressure
3.3 atm

Ionization Potential
9.99 eV

Flash Point
NA (Gas)

Upper Exposive Limit
33.0%

Lower Explosive Limit
3.6%

Relative Gas Density
2.21

APPENDIX

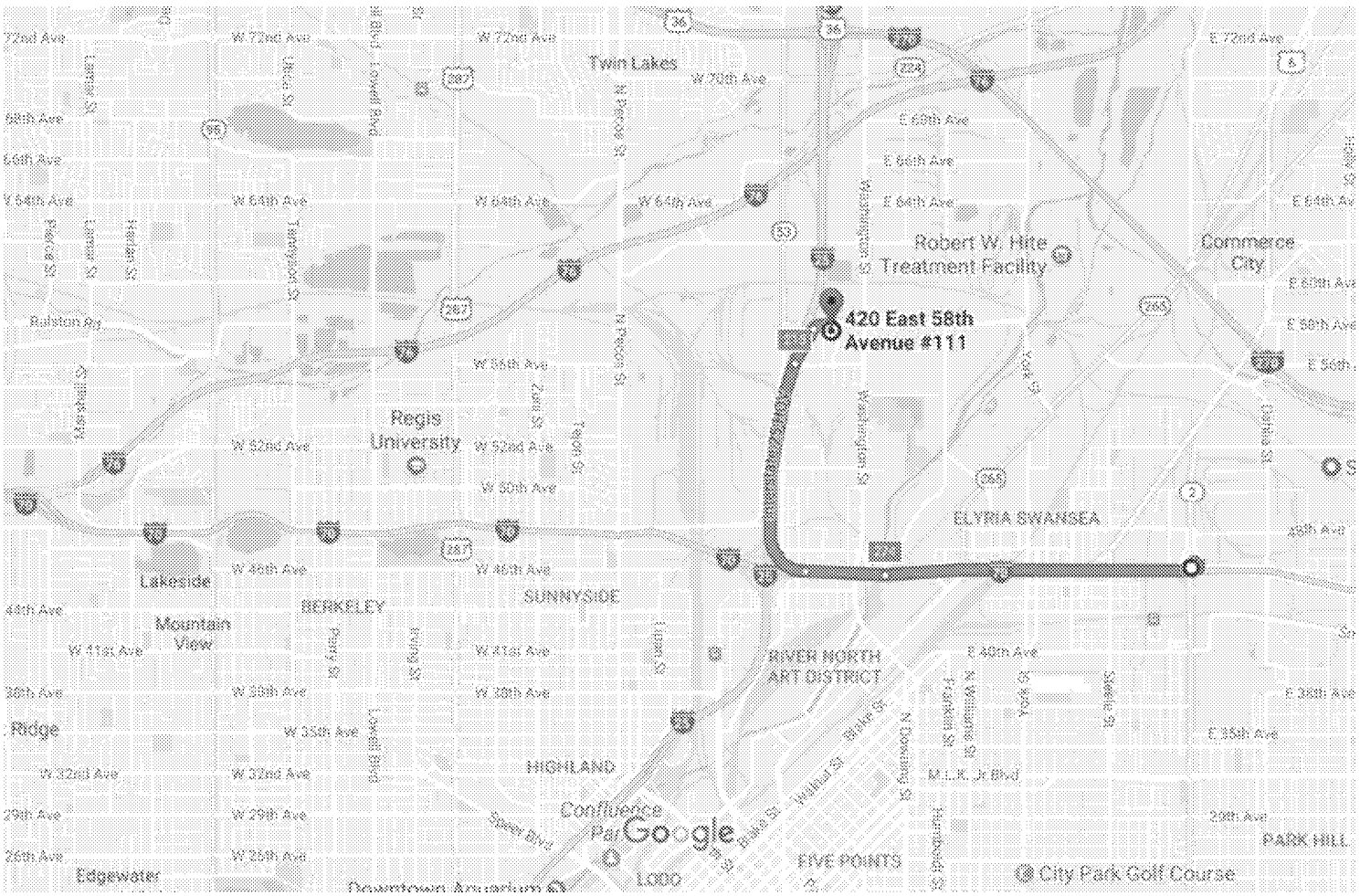
F ROUTE TO HOSPITAL

Google Maps

4600 Colorado Blvd, Denver, CO 80216 to 420 E 58th Ave #111, Denver, CO 80216

Drive 4.3 miles, 5 min

Concentra Urgent Care



Map data ©2017 Google 1 mi

4600 Colorado Blvd

Denver, CO 80216

Get on I-70 W

20 s (0.1 mi)

1. Head north on Colorado Blvd

72 ft

2. Slight right to merge onto I-70 W toward US-6 W/US-85 S/Grand Jct

0.1 mi

Continue on I-70 W. Drive to E 58th Ave in North Washington. Take exit 215 from I-25 N

5 min (4.0 mi)

3. Merge onto I-70 W

1.9 mi

4. Use the right lane to take exit 274 for Interstate 25 toward Fort Collins/Colo Springs

0.5 mi

5. Keep right at the fork, follow signs for I-25 N/Thornton/Ft Collins and merge onto I-25 N

1.4 mi

6. Use the right lane to take exit 215 for 58th Ave

0.2 mi

7. Turn right onto E 58th Ave (signs for Logan St S/Colorado National Guard)

Destination will be on the right

25 s (0.1 mi)

420 E 58th Ave #111

Denver, CO 80216

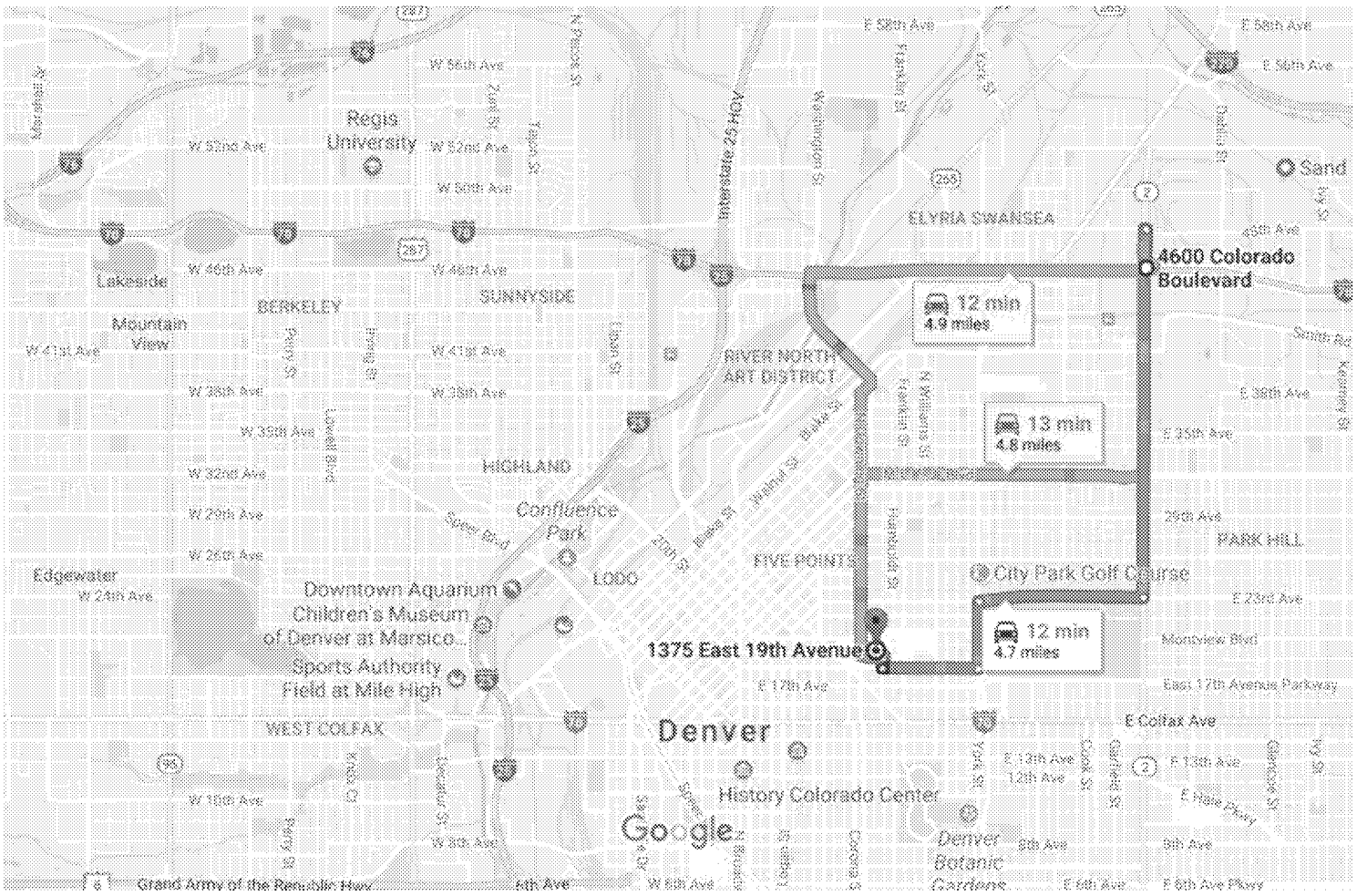
These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Google Maps

4600 Colorado Blvd, Denver, CO 80216 to 1375 E 19th Ave, Denver, CO 80211

Drive 4.7 miles, 12 min

Saint Josephs Hospital



4600 Colorado Blvd

Denver, CO 80216

1. Head north on Colorado Blvd — 0.2 mi
2. Make a U-turn at 48th Ave — 2.3 mi
3. Turn right onto E 23rd Ave — 1.0 mi
4. Turn left onto York St — 0.4 mi
5. Turn right onto E 18th Ave — 0.6 mi
6. Turn right onto N Lafayette St — 341 ft

7. Turn right

Destination will be on the right

354 ft

1375 E 19th Ave

Denver, CO 80211

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.

Google Maps

4600 Colorado Blvd, Denver, CO 80216 to 3001 Havana St, Denver, CO 80238

Drive 6.0 miles, 9 min

Concentra Urgent Care

4600 Colorado Blvd

Denver, CO 80216

1. Head north on Colorado Blvd — 0.2 mi
2. Make a U-turn at 48th Ave — 0.3 mi
3. Use the right lane to merge onto I-70 E via the ramp to Aurora Limon — 4.2 mi
4. Take exit 280 for Havana St — 0.3 mi
5. Use any lane to turn left onto Havana St — 1.0 mi

3001 Havana St

Denver, CO 80238

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.

Google Maps

4600 Colorado Blvd, Denver, CO 80216 to 5855 Stapleton Dr N #130

Drive 2.1 miles, 7 min

Concentra Urgent Care

Map data ©2017 Google 1 mi

4600 Colorado Blvd

Denver, CO 80216

1. Head north on Colorado Blvd — 0.2 mi
2. Turn right onto 48th Ave — 102 ft
3. Turn right at the 1st cross street onto E 46th Ave — 141 ft
4. Turn left onto 48th Ave — 1.2 mi
5. Turn right onto Leyden St — 0.4 mi
6. Turn right onto Stapleton Dr N
   Destination will be on the right — 0.2 mi

5855 Stapleton Dr N #130

Denver, CO 80216

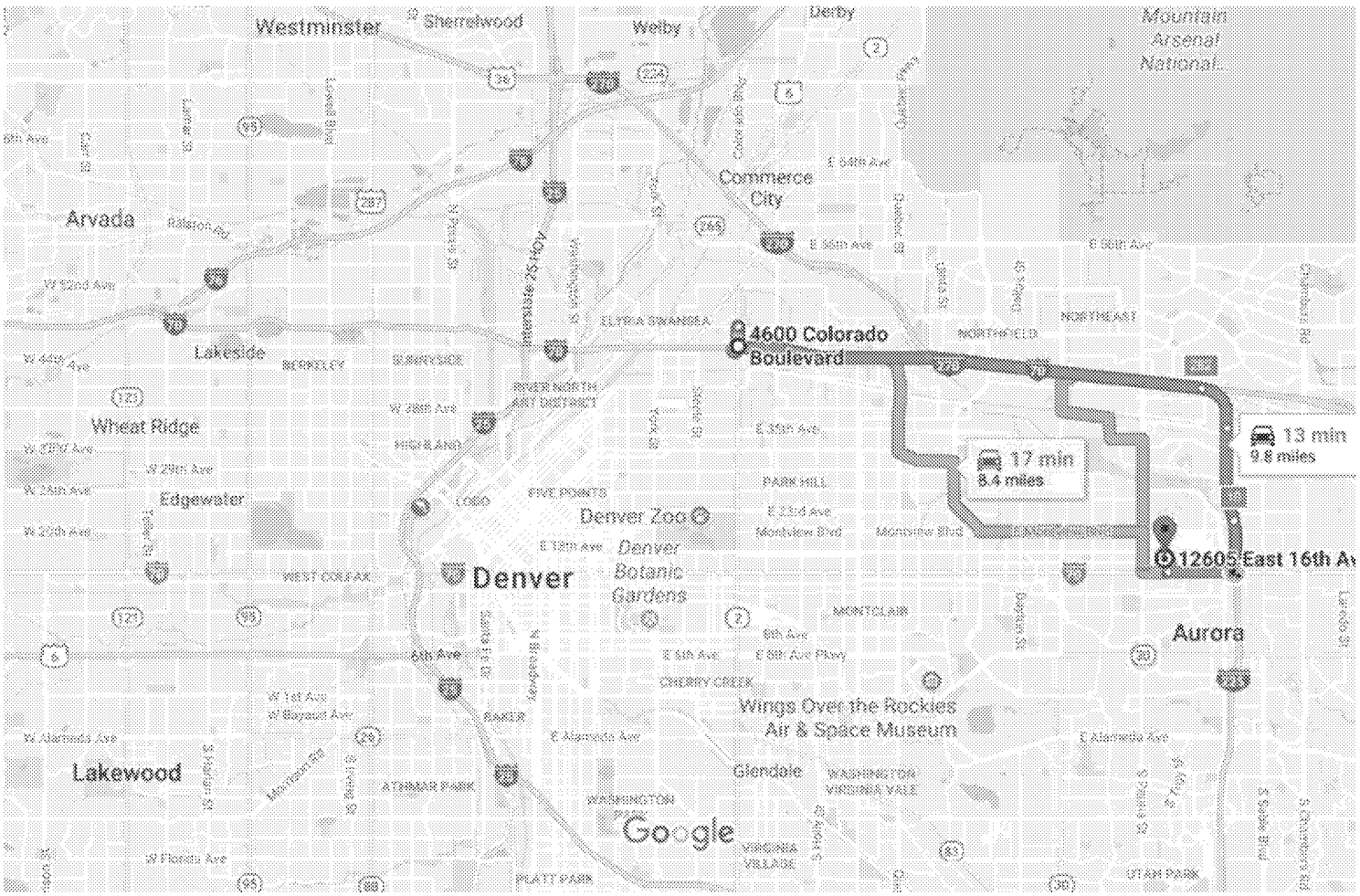
These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Google Maps

4600 Colorado Blvd, Denver, CO 80216 to 12605 E 16th Ave, Aurora, CO 80045

Drive 9.8 miles, 13 min

University of Colorado Hospital



4600 Colorado Blvd

Denver, CO 80216

Get on I-70 E

2 min (0.7 mi)

1. Head north on Colorado Blvd

0.2 mi

2. Make a U-turn at 48th Ave

0.3 mi

3. Use the right lane to merge onto I-70 E via the ramp to Aurora Limon

0.1 mi

Continue on I-70 E to Aurora. Take exit 10 from I-225 S

9 min (8.2 mi)

4. Merge onto I-70 E

5.7 mi

5. Use the right 3 lanes to take exit 282 for I-225 S/I-225 toward Aurora/Colorado Springs

0.7 mi

6. Continue onto I-225 S

1.1 mi

7. Use the right 2 lanes to take exit 10 toward Route 40

0.4 mi

8. Keep right at the fork, follow signs for Colfax Ave

0.2 mi

Continue on E Colfax Ave to your destination

3 min (1.0 mi)

9. Use the right 2 lanes to turn right onto E Colfax Ave

0.8 mi

10. Turn right

Destination will be on the right

0.2 mi

12605 E 16th Ave

Aurora, CO 80045

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.

APPENDIX

G

METHAMPHETAMINE DRUG LAB DISCOVERY

Foothills Environmental, Inc.

Industrial Hygiene, Safety & Environmental Services

METHAMPHETAMINE DRUG LAB DISCOVERY STANDARD OPERATING PROCEDURES

The following procedures provided in this Standard Operating Procedure (SOP) are designed for site personnel to follow in the event that a methamphetamine drug lab is discovered during the performance of work activities for the Central 70 highway reconstruction Project. This SOP is designed to provide site workers information for awareness of suspect methamphetamine drug lab and safety and notification procedures to protect the worker and public from chemicals associated with clandestine methamphetamine drug labs. The Colorado Department of Public Health and Environment (CDPHE), State Board of Health has regulations for Cleanup of Methamphetamine-Affected Properties under 6 CCR 1014-3.

1.0 DRUG LAB AWARENESS

There is a potential to encounter methamphetamine drug lab paraphernalia (needles, lab cookware, hazardous chemicals, death bags containing phosphine gas) during the structure survey assessments for abandoned buildings located in the Project ROW. Methamphetamine drug laboratory paraphernalia, cook ware and chemical products may also be encountered in vehicles, suitcases and at outdoor locations within the project boundary.

1.1 DRUG LAB DISCOVERY NOTIFICATION PROCEDURES

If suspicious drug activity, or if drug paraphernalia, laboratory cookware, chemicals or evidence of methamphetamine laboratory is discovered, immediately leave the area and notify KMP Supervisor, Environmental Manager and HSO.

1.2 ASSESSMENT OF BUILDINGS WITH EVIDENCE OF METH LAB ACTIVITY

If methamphetamine laboratory cookware or chemical products are discovered, then the building will be considered a meth affected property and only emergency response and HAZWOPER trained personnel will be allowed to enter the building.

If hazardous chemicals are discovered, hazardous materials response teams will be called to respond to chemical hazards. Only personnel possessing the proper personal protective equipment, monitoring equipment and training will be allowed to enter the building.

1.3 DEMOLITION OF METH AFFECTED PROPERTIES

Any chemicals discovered within structures or on the property must be properly disposed in accordance with CDPHE solid and hazardous waste regulations. Cleanup of meth affected building materials is not required as long as the chemical hazard are remediated and the meth-affected property is scheduled for

ED_002842A_00000589-00395

demolition. Under CDPHE Regulation 6 CCR 1014-3, Section 1.4, Materials that are removed or demolished in lieu of decontamination must be disposed of at a solid waste landfill, but are not subject to regulation under this Part 1.

However, under CDPHE Regulation 6 CCR 1014-3, once a meth affected property is identified, only personnel that are HAZWOPER certified are allowed to enter the building to complete the structural assessments. For asbestos abatement activities, only CDPHE asbestos and methamphetamine certified Contractors are allowed to perform abatement.

APPENDIX

H KIEWIT CONFINED SPACE ENTRY PROGRAM

POLICY 16.0

CONFINED SPACE PROGRAM

1.0 SCOPE

It is the intention of the Central District to fully comply with the Occupational Safety and Health Administration (OSHA) Permit Required Confined Spaces, as outlined in 29 Code of Federal Regulation (CFR) 1910.146. Entering or working in confined spaces routinely subject's workers to hazards that can cause illness, bodily injury, or death. Any space above or below ground with poor natural ventilation or physical hazards that meets the definition of a confined space shall be evaluated in accordance with this policy.

The most current Non-Permit Required Confined Space Checklist and the Permit Required Confined Space Permit can be found on the Central District's Portal Site.

Background
A **Confined Space** is defined as:

- Size and shape allow someone to enter.
- Limited openings to allow workers to enter and exit.
- Not designed for continuous occupancy.
- Limited natural ventilation.

Examples of confined spaces include: manholes, stacks, pipes, storage tanks, trailers, tank cars, pits, sumps, hoppers, and bins.

A **Permit Required Confined Space** meets all of the above criteria but also has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere.
- Contains a material that has the potential for engulfing an entrant; examples: soil, grain, and water.
- 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; examples: bens and silos.
- Contains any other recognized serious safety or health hazard.

2.0 REQUIREMENTS

All confined spaces shall be classified as either a non-permit space or a permit-required confined space prior to entry.

Confined Space Evaluation and Marking
All Central District projects shall:

- Perform a documented evaluation for the presence of confined spaces at the project.
- Determine which spaces meet the definition of a permit-required confined space.
- Post all confined spaces with appropriate signage.
- Evaluate whether existing confined spaces will require entry during the project.

Non-Permit Required Confined Spaces
Confined spaces may be entered without the need for a written permit or use of an attendant provided that:

- The space is determined not to be a permit required confined space.
- The space can be maintained in a safe condition for entry by mechanical ventilation alone.
- OSHA defines a non-permit confined space as a confined space that does not contain, or in the case of atmospheric hazards does not have the potential to contain any hazard capable of causing death or serious physical harm to an entrant. If testing and inspection confirm one or more hazards in a permit space, but these hazards can be completely eliminated, the space may be reclassified as a non-permit confined space.

Non-Permit Spaces require the completion of:

- Non-permit required confined space checklist.

Training
All employees that are required to enter any type of confined space shall be trained on this policy and of the specific space they will be entering. Training shall include:

- PPE requirements.
- Air monitoring.
- Communication.
- Type of space.
- Configuration of the space.
- Entry and exit points.
- Emergency procedures.

Permit Required Confined Spaces
If it is determined that a permit required confined space must be entered then the following requirements must be followed.

1. **Pre-Entry Hazard Assessment**
   A hazard assessment (Kiewit Hazard Analysis) shall be completed by the Job Superintendent prior to any entry into a confined space. The hazard assessment (Hazard Analysis) should identify:
   - Sequence of work to be performed in the confined space.
   - Hazards known or anticipated.
   - Control measures to be implemented to eliminate or reduce each of the hazards to an acceptable level.

   No entry shall be permitted until the hazard assessment has been reviewed and discussed by all persons engaged in the activity. Personnel who are to enter confined spaces shall be informed of known or potential hazards associated with the spaces.
2. **Confined Space Entry Permit**
   Prior to entry into any permit-required confined space, the Job Superintendnet will issue a confined space entry permit that specifies the location, type, and duration of the work to be done, and the date. The permit will certify that all existing hazards have been evaluated by the supervisor and that necessary protective measures have been taken for the safety of workers. It will provide documentation of the atmospheric testing that has been done. It will assign entry and attendant duties to specific personnel.

Entry permits are to be posted at the entrance to the confined space. OSHA 29 CFR 1910.146 requires that copies of all completed and/or canceled entry permits will be retained for one year after completion of an entry.

Before issuing an entry permit, the Job Superintendent will be responsible for ensuring the following:

- Identify all hazards and potential hazards associated with the confined space, such as the danger of explosion, asphyxiation, toxic gases/fumes, engulfment or entrapment, electrical or mechanical hazards, etc.
- Isolate the space from potential hazards, if possible, to provide for safe entry.
- Purge, inert, flush, or ventilate to eliminate atmospheric hazards.
- Provide external barriers and warning signs.
- Conduct air monitoring. All test results are to be recorded on the entry permit. If potential hazards cannot be isolated, continuous monitoring is required. If potential hazards can be isolated, periodic monitoring is required.
- Provide at least one trained attendant outside of each confined space that will be entered.
- Ensure that rescue and emergency services and equipment are in place as noted in this policy.
- Ensure that all required equipment is provided, maintained and properly used. This includes air monitoring equipment, forced air ventilation equipment, communications equipment, personal protective equipment (PPE), lighting, external barriers and warning signs, ladders, and rescue equipment.

If hazardous conditions are detected during entry, employees will immediately leave the space and the Job Superintendent will evaluate the cause of the hazardous atmosphere and take corrective actions before allowing re-entry.

Self Rescue

Self rescue is when the entrants of the space remove themselves from the space when conditions change and/or become worse within the space. The space is evacuated without outside assistance. This is the preferred method for removing entrants from a confined space. This can usually only be obtained when the entrants walk in and out of the space.

Off-Site Rescue Services

When a permit required confined space entry is conducted on a Central District project, coordination with off-site confined space rescue services shall be completed. The rescue service shall be informed of the intent to enter a permit required confined space and the expected hazards of the space.

Confined Space Training

All Central District employees who work in confined spaces, permit or non-permit required, shall receive training that provides them with the knowledge, skills and understanding to safely enter, work in and exit from confined spaces. This training shall include identification of the specific duties of the attendant, entry supervisor and entrants. This training shall be provided by an experienced and knowledgeable person.

Subcontractors Entering Confined Spaces
When a subcontractor is required to enter a permit-required confined spaces on a Central District controlled site, the Job Superintendent shall:

- Ensure that the subcontractor has a confined space entry program meeting the requirements of 29 CFR 1910.146 and that the subcontractor's employees have received appropriate training.
- Not perform monitoring or issue permits for the sub-contractor.
- Not perform entrant, attendant or supervisor duties for the sub-contractor entry.

3.0 ENTRY PROCEDURES

Atmospheric Air Monitoring
Prior to entry, all spaces will be initially tested for flammable vapors and oxygen deficiency, plus toxic vapor or gases (based on the potential for toxins being present). Periodic or continuous monitoring will be conducted for as long as the space is occupied and is appropriate for the hazard involved. Records will be maintained on the confined space permit and retained for one year.

OSHA requires that the monitoring be conducted in the following specific order:

- Oxygen.
- Lower Explosive Limit (LEL).
- Other chemicals as necessary i.e. hydrogen sulfide, carbon monoxide, benzene, etc.

The Central District shall use a 4- Gas air monitor for all confined spaces. The four gasses are O_2 (oxygen), CO (carbon monoxide), LEL, and H_2S (hydrogen sulfide).

The person assigned the task of monitoring shall know the proper procedure for the calibration and operation of all sampling equipment in accordance with manufacturer's requirements.

Each instrument used will be field calibrated prior to daily use to ensure that it is properly calibrated and that it is functioning properly. Combustible gas indicators (CGI) or other direct reading instruments will not be used for certifying an area "safe for entry" if their calibration has not been confirmed with appropriate calibration gas.

Monitoring readings will be made from bottom to top and in all remote sections of space. Monitoring personnel must always confirm that a lack of LEL reading is not caused by low oxygen concentrations.

Continuous monitoring inside the space for flammables, oxygen deficiency, and/or toxic gas and vapor will be necessary where inside conditions could rapidly change. Example situations would include when welding or cutting inside the space, using previously covered contaminants could become airborne, dismantling pipe work or other structures that could contain contaminants, etc.

Once ventilation is started, periodic checks should be made of the surrounding area (where the contaminated air is exhausted) to ensure that no hazard is presented to people or equipment.

If the air monitor malfunctions in any way the space will be cleared by ALL personnel immediately.

If the air monitor's alarms sound for any air contamination for any of the detectable gasses the space shall be immediately cleared.

4.0 RESPONSIBILITIES

The following persons shall be responsible, at a minimum, for actions as indicated below.

Management

- Responsible for the implementation of the program.
- Evaluate site for confined spaces.
- Determine if confined spaces are permit or non-permit required.
- Ensure that only qualified entrants go into confined spaces.
- Ensure that appropriate PPE and emergency services are provided to entrants.
- Ensure that sub-contractors have a confined space program prior to entering a confined space on site.
- Ensure that confined space permits are being completed.

Entry Supervisor

The entry supervisor is responsible for the evaluation of the confined space and authorization of personnel to enter. The entry supervisor's authority must be documented in writing on the confined space permit. The entry supervisor's duties include:

- Ensuring confined space entry permits are posted and that a confined space authorized attendant is present during all entry activities.
- Ensuring that all personnel have received proper training in confined space entry procedures and proper use of safety retrieval equipment in an emergency.
- Ensuring that all necessary safety retrieval equipment is on site, operational, and properly deployed prior to entry.
- Ensuring that appropriate measures are implemented so that confined spaces will not be inadvertently entered by employees in the area.

Support Personnel

Entry into a confined space shall be made only when enough outside support personnel are available to handle communication, support equipment, and to provide assistance or emergency aid as necessary.

- This individual must be dressed in the same level of protection as the entry person.
- He/she must be stationed at the opening to the space in direct line of sight or contact with those inside.
- This person will be on station the entire time that operations are being conducted.

Attendant

The attendant shall stay at his/her post outside the permit space to observe conditions and support the entrant. The attendant is responsible for:

- Knowing the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure.
- Being aware of possible behavioral effects of hazard exposure in authorized entrants.
- Continuously maintaining an accurate count of authorized entrants in the permit space and ensuring that the means used to identify authorized entrants accurately identifies who is in the permit space.

- Remaining outside the permit space during entry operations until relieved by another attendant.
- Communicating with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space.
- Monitoring activities inside and outside the space to determine if it is safe for entrants to remain in the permit space. Immediately remove all entrants under any of the following conditions:
    - If the attendant detects a prohibited condition.
    - If the attendant detects the behavioral effects of hazard exposure in an authorized entrant.
    - If the attendant detects a situation outside the space that could endanger the authorized entrants.
    - If the attendant cannot effectively and safely perform all the duties required.
- Summoning rescue and other emergency services as soon as he/she determines that authorized entrants may need assistance to escape from permit space hazards.
- Taking the following actions when unauthorized person's approach or enters a permit space while entry is underway:
    - Warning the unauthorized persons that they must stay away from the permit space.
    - Advising the unauthorized persons that they must exit immediately if they have entered the permit space.
    - Informing the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.
- Performing non-entry rescue as specified by the program's rescue procedure.
- Performing no duties that might interfere with his/her primary duty to monitor and protect the authorized entrants.

Employees

- Identify confined spaces at sites.
- Attend confined space training as necessary.
- Not enter confined spaces unless trained to do so.

APPENDIX

I

PROJECT AGREEMENT SPECIAL PROVISION 250 SPECIFICATION

SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

Section 250 of the Standard Specifications is hereby deleted for this project and replaced with the following:

DESCRIPTION

250.01 This work consists of protection of the environment, persons, and property from contaminants that may be encountered on the Project. This includes monitoring the work for encounters with contaminants or suspected soil and groundwater contaminants; the management of solid, special, and hazardous waste; and management of visual emissions associated with hazardous waste, when encountered on the project.

250.02 The Contractor shall furnish all personnel, materials, equipment, laboratory services and traffic control necessary to perform the contamination monitoring, testing, and site remediation when required. Traffic control shall be in accordance with the requirements of Section 630.

Monitoring equipment used to detect flammable gas, oxygen level, and toxic gas shall be capable of detection to meet the following standards:

Instrument Detection		
Constituent	**Threshold Limit**	**Increments**
Flammable Gas	1% LEL	1%
Oxygen	19%	0.1%
Toxic Gas	1 PPM	1 PPM
LEL = lower explosive limit PPM = parts per million		

CONSTRUCTION REQUIREMENTS

250.03 General. Prospective bidders, including subcontractors, are required to review the environmental documents available for this project included in Schedule 29 (*Reference Documents*).

This project is in the vicinity of property associated with petroleum products, heavy metal based paint, landfill, buried foundations, abandoned utility lines, industrial area or other sites which can yield Hazardous Substances or produce dangerous gases. These Hazardous Substances or gases can migrate within or into the construction area and could create hazardous conditions. The Contractor shall use appropriate methods to reduce and control known landfill materials, industrial gases, and visible emissions from asbestos encounters and hazardous substances which exist or migrate into the construction area. The Contractor shall follow CDOT's *Regulated Asbestos Contaminated Soil Management Standard Operating Procedure, dated October 20, 2016* for proper handling of asbestos-contaminated soil, and follow all applicable Solid and Hazardous Waste Regulations for proper handling of soils encountered that contain any other substance mentioned above.

Encountering suspected contaminated material, including groundwater, old foundations, building materials, demolition debris, or utility lines that may contain asbestos or be contaminated by asbestos, is possible at some point during the construction of this project. When suspected contaminated material, including groundwater, is encountered or brought to the surface, the procedures under subsection 250.03(d) and 250.05 shall be followed.

SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

Transportation of waste materials on public highways, streets and roadways shall be done in accordance with Title 49, Code of Federal Regulations (C.F.R.). All labeling, manifesting, transportation, etc. of waste materials generated on this project shall be coordinated with the Department. All hazardous waste manifests for waste materials generated on this project shall list the Colorado Department of Transportation as the generator of the waste materials except as otherwise noted. If the Contractor contaminates the site, the Contractor shall be listed as the generator on the hazardous waste manifests, permits, and other documents for such material.

If waste materials must be handled in a permitted treatment, storage and disposal (TSD) facility, the facility shall be coordinated with the Department. The hazardous waste transportation phase of the work involves insurance required by law and regulations. If the waste materials are determined to be hazardous, the Contractor must submit proof that the transportation company is covered by the appropriate type and amount of insurance required by laws and regulations governing the transportation of hazardous waste.

The Contractor alone bears the responsibility for determining that the work is accomplished in strict accordance with all applicable federal, state and local laws, regulations, standards, and codes governing special waste, petroleum and hazardous substance encounters and releases.

A Health and Safety Officer, Monitoring Technician, and Health and Safety Plan (HASP) are required in accordance with Section 23.21.2, 23.21.3 and 23.11 of Schedule 17, respectively.

(a) *Health and Safety Officer (HSO).* The Contractor shall designate a HSO in accordance with Section 23.21.2 of Schedule 17. The HSO can delegate task to their designee as long as the designee meets the training and certification requirements stated above for the HSO.

The HSO shall *be* equipped with the following:

1. Communication equipment as required in subsection 250.03(d)2.A. and a vehicle.

2. Monitoring and detection equipment for flammable gas, oxygen sufficiency, toxic gas, radiological screening and other hazards. This includes, as required, a combustible gas indicator, flame ionization or photo ionization detector, oxygen meter, radiation monitor with Geiger Mueller detector and other foreseeable equipment.

3. Depth gauging equipment, sampling equipment and sampling containers.

4. Personal protective equipment (PPE), when required. PPE must be selected which will provide protection from the specific hazards which are likely to be encountered during work on the project.

The HSO shall recommend and supervise those actions which will minimize the risk of Hazardous Substance related injury to the workers, Department personnel, the general public, property and the environment. The HSO shall prepare written procedures for the monitoring of confined space entry and working in or near excavations, including but not limited to trenches and drill holes associated with this project. The HSO shall ensure that all hazardous substance and solid waste related testing, sampling, monitoring and handling for this project to ensure compliance with applicable statutes

and regulations, and other applicable environmental requirements under subsections 107.01 and 107.02.

The HSO shall be available for consultation and assistance with contaminated materials related testing, sampling, and field monitoring as required on the project.

The HSO shall prepare a daily diary which shall be submitted to the Department on a monthly basis in the Monthly Statement of Recognized Hazardous Materials Management. The diary shall contain a chronological log of activities on the project including: dates and times on site, equipment used and calibrations, field monitoring results, visual observations, conversations, directives both given and received related to health and safety.

(b) *Monitoring Technician (MT).* The Contractor shall designate monitoring technicians to be responsible for monitoring of Hazardous Substances during work on the project in accordance with Section 23.21.3 of Schedule 17. The MT shall have a minimum of two years of actual field experience in assessment and remediation of hazardous substances that may be encountered during highway construction projects. The MT shall be experienced in the operation of monitoring devices, identifying substances based upon experience and observation, and field sampling (for testing) of all media that may be found on the site. Completion of the 40 hour hazardous waste and 8 hour supervisory training required by OSHA and U.S. EPA rules and regulations, which complies with the accreditation criteria under the provisions of the proposed 29 C.F.R. 1910.121 is required prior to beginning work. The Contractor shall furnish documentation at the Preconstruction Conference that demonstrates these requirements have been met.

The MT shall be equipped with the following:

1. Communication equipment as required in subsection 250.03(d)2.A. and a vehicle.

2. Monitoring and detection equipment for flammable gas, oxygen sufficiency, toxic gas, radiological screening and other hazards. This includes, as required, a combustible gas indicator, flame ionization or photo ionization detector, oxygen meter, radiation monitor with Geiger Mueller detector and other foreseeable equipment.

3. Personal protective equipment, when required. PPE must be selected which will provide protection from the specific hazards which are likely to be encountered during work on the project.

The MT shall be present on site and perform monitoring as required by 250.03(d) when work is being performed in areas of known or suspected Hazardous Substances.

The MT shall monitor for compliance with regulations, the project Health and Safety Plan and the Materials Management Plan, the Contract, and the environmental documents for the project. The MT shall immediately notify the Environmental Manager and the HSO of any hazardous condition.

(c) *Health and Safety Plan (HASP).* The HSO shall prepare a written HASP for the project focused on Hazardous Substances, formatted as shown in Appendix B, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, DHHS (NIOSH) Publication Number 85-

115, available from the Superintendent of Documents, U.S. Government Printing Office, including all applicable sections from 29 C.F.R. 1910 and 29 C.F.R. 1926.

Within five calendar days after Acceptance by the Department, the HSO shall distribute signed and stamped (or sealed) copies of the accepted HASP to each emergency response agency servicing the project area and the HASP designated emergency hospital. Earth or demolition work

shall not occur until after the HASP is accepted and the HASP has been distributed. The HASP shall also be available to the Contractor's employees, their representatives, and officials of OSHA, EPA, Colorado Department of Public Health and Environment (CDPHE), local government health department, Federal Highway Administration, and other appropriate agencies, as requested. The Contractor will distribute the accepted HASP to appropriate Department personnel. The HASP shall be kept current and shall be revised by the HSO as warranted by changes in the field conditions.

All on-site workers (Contractor's, Department's, Utilities', and others) shall be briefed by the HSO on the contents of the HASP and any revisions thereof. The HSO shall conduct briefings (group or individual) to inform all new employees, subcontractors, utility companies and other on-site workers of the HASP contents prior to their entry on site. All personnel involved in excavation or other soil disturbing activities shall receive the required two-hour Asbestos Awareness training by a Certified Asbestos Inspector, when asbestos discoveries are anticipated, or discoveries are made.

A signature log of all briefing attendees shall be kept and provided in the Environmental Status Report (see Schedule 17, Section 4).

The Contractor shall provide, as required, eye wash equipment and stations, emergency showers, hand and face washing facilities and first aid equipment.

The Contractor shall provide, as required, decontamination facilities for personnel and equipment employed in the work. The exact procedure for decontamination and frequency shall be included in the accepted HASP. Decontamination facilities shall meet the criteria set forth in the Code of Federal Regulations (29 C.F.R. and 40 C.F.R.).

(d) *Precautions and Procedures.* The following minimum precautions and procedures shall be followed during the construction of the project:

1. General construction precautions:

A. All monitoring and piezometer wells and test borings shall be established or abandoned by the Contractor as regulated by the State Engineer's Office. Copies of all required permits, notification, and abandonment documents shall be submitted to the Department as part of the Monthly Statement of Recognized Hazardous Materials Management.

B. The Contractor shall properly handle all investigation derived waste generated by this project. Documentation shall be submitted to the Department as part of the Monthly Statement of Recognized Hazardous Materials Management of all tests performed for

TSD determination; classification of waste; hauling records; TSD acceptance; manifest (if required); etc. in accordance with applicable laws and regulations.

2. For construction on a known or potentially contaminated site, the following conditions shall apply, in addition to those listed in subsection 250.03(d)1:

A. The HSO, or their designee identified in the HASP, shall be on site or readily available by radio, telephone or pager at all times during the work. When on site, the HSO, or their designee identified in the HASP, shall have an operational portable or mobile

cellular telephone available for immediate use in areas where such service is available. When on site in cellular telephone non-service areas, the HSO, or their designee identified in the HASP, shall have available, for immediate use, radio access to a site with telephone service. The HSO shall be notified at least 24 hours prior to the start of confined space entry, storage tank removal, drilling, excavation, trenching, or dewatering operations.

B. The HSO shall designate the onsite monitoring equipment for flammable gases, oxygen deficient or enriched atmosphere, and toxic gases, such as but not limited to, a flame ionization detector, photoionization detector, combustible gas indicator, and oxygen meter. This designated equipment shall be on site during all construction operations and be utilized during trenching, drilling, excavating, confined space entry, underground storage tank removal, and other appropriate construction operations. The exact equipment to fulfill this requirement shall be specified in the accepted HASP. The HSO, or their designee identified in the HASP, shall conduct or supervise the monitoring. The monitoring equipment shall be calibrated as recommended by the manufacturer.

C. When drilling, trenching, or excavating in the presence of detectable concentrations of explosive gases, the soil shall be wetted and the operating equipment shall be provided with spark proof exhausts.

D. The Contractor, through the HSO, is responsible for ensuring that 29 C.F.R. 1926 is fully complied with during the construction of the project.

E. Affected excavation operations shall be discontinued and personnel shall be removed from the affected excavation sites where any of the following levels are detected:

(1) 20.0 percent or more LEL flammable gas, or 10.0 percent in an underground or confined space,

(2) Permissible Exposure Limit (PEL) of any toxic gas,

(3) 19.5 percent or less oxygen,

(4) 25.0 percent or more oxygen,

SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

(5) Greater than 2 mrem/hr. (Beta particle & photon radioactivity),

(6) Greater than 15 pCi/L (Gross alpha particle activity), or

(7) Other action levels as determined by the HSO.

(8) Uncovering of suspect Asbestos Containing Material (ACM), including but not limited to, buried facility components, active or abandoned utility lines, buried foundations and demolition debris, or miscellaneous ACM dispersed in the soil. The Contractor shall follow the procedures outlined in the *CDOT's Regulated Asbestos Contaminated Soil Management Standard Operating Procedure, dated October 20, 2016*, HASP and 29 C.F.R. 1926 to address these conditions.

F. Personnel shall be issued and utilize appropriate Health and Safety equipment as determined by the HSO.

G. Personnel shall avoid the area immediately downwind of any excavation unless the excavation is monitored and declared safe.

H. The operators of excavating, trenching, or drilling equipment shall wear appropriate PPE as required in the HASP.

I. Exhaust blowers shall be present at the location where required in the accepted HASP.

J. The Contractor shall accomplish the work with employees who have been trained and equipped as required by the HASP and applicable provisions of 29 C.F.R. 1910 and 29 C.F.R. 1926.

K. Fire extinguishers, electrical equipment and wiring shall conform to the applicable requirements of 29 C.F.R. 1926 and 49 C.F.R..

L. Smoking shall not be permitted within 50 feet of any excavation.

3. For construction within 1000 feet of a known or potentially contaminated site, the following conditions, in addition to those listed in subsection 250.03(d) shall apply:

A. The areas under construction shall be checked with a combustible gas indicator before excavation begins to determine if flammable or combustible gas is in the area.

B. Excavations, trenches and drill holes shall be monitored by the HSO, or their designee identified in the HASP, for flammable gas, toxic gas and oxygen deficiency or enrichment. This shall be carried out continuously unless the presence of flammable, combustible or toxic gas, or oxygen deficiency or enrichment in the area can be ruled out by the HSO, or their designee identified in the HASP.

C. When flammable or toxic gas is found in the area, those precautions and procedures in subsection 250.03(d)2 shall apply.

-7-

SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

250.04 Heavy Metal Based Paint Management. When the work includes the removal of paint or items covered with paint which may contain lead, chromium or other heavy metals, the requirements of this subsection shall apply in addition to the requirements of subsection 250.03.

The requirements of the HASP shall be in accordance with OSHA Publication Number 3142, *Working with Lead in the Construction Industry.*

Paint Removal and Waste Disposal work shall be performed in accordance with 29 C.F.R. 1926.62, State and local air quality regulations, the Steel Structures Painting Council (SSPC) Guide for Containing Debris Generated During Paint Removal Operations, the *Industrial Lead Paint Removal Handbook* (SSPC 91-18), and the references contained therein.

The following minimum precautions and procedures shall be followed unless modified in the approved HASP or its updates:

The Contractor shall contact the CDPHE, Air Pollution Control Division to ascertain if an air pollution permit is required for the cleaning or demolition work. If an air pollution permit is required, the Contractor shall obtain the permit. The Contractor shall furnish the Department with a copy of the permit application and the permit issued prior to starting cleaning or demolition activities. A copy of the Air Pollution Emission Notice (APEN) shall be provided to the Department, if such notice is required under the Colorado Air Quality Control Commission's regulations. The processing of air pollution permits in non-attainment areas, or where public hearings are required, likely will take more than 90 days.

(a) The Contractor shall contain paint chips, corrosion residues, and spent abrasives, herein referred to as waste materials, resulting from the cleaning or demolition operations. The Contractor shall not deposit or release waste material into the water, air or onto the ground below or adjacent to the structure. The Contractor shall conduct cleaning operations to minimize the waste materials produced. Prior to beginning the work, the Contractor shall submit to the Department for acceptance, a detailed methods statement for capturing, testing, and disposing of the removed materials.

(b) Abrasives utilized for blast cleaning shall be low-dusting and low waste. Unless approved otherwise, vacuum blasting or wheel blasting shall be used.

(c) The Contractor shall sample and test the waste material for lead, chromium, and other paint associated heavy metals using the Toxicity Characteristic Leaching Procedure (TCLP) Test, Method 1311 of the EPA publication, Test Methods for Evaluating Solid Waste 846. Sample collection methodology and frequency shall be defined in the Sampling and Analysis Plan (see Section 23.10 of Schedule 17) with an adequate number of samples taken to be representative of all waste material collected. If the waste material does not pass the TCLP test, it shall be disposed of in a permitted TSD facility as designated in writing by the Department. The waste materials handling, including a description of sample collection methodology, testing performed, test results and comparison of test results with hazardous waste requirements shall be documented in the Monthly Statement of Regulated Hazardous Materials Management and Recognized Hazardous Materials Completion Report. The waste material shall not be held at an unpermitted TSD facility site in excess of Resource Conservation and Recovery Act (RCRA) temporary storage time limits.

(d) When an item coated with paint is removed, all loose paint shall be removed and collected from the item within 24 hours of the time it is removed or placed onto the ground. All loose paint shall be removed and collected from a painted item before it is removed from the site. The Contractor shall contain loose paint until it is removed and collected. Loose paint is defined as that which can be removed by manual scraping methods. Over waterways, the Contractor shall capture all paint debris by the method specified in the methods statement. The paint debris shall be collected on a daily basis and shall be stored in a properly labeled, tightly sealed container and placed in a secured location at the end of each working day.

(e) All painted steel components which are not designated to be salvaged shall be recycled. Contractor possession of the steel for future use shall be considered a form of recycling. Prior to transport of the components off-Site, the Contractor shall obtain a letter from the recipients of the painted steel components stating that they have been fully informed of the contents of the paint and are capable of handling the paint. If the Contractor is to maintain future possession of the steel, the Contractor shall supply this letter. If there will be more than one recipient of the painted material, one letter shall be obtained from each recipient. The Contractor shall provide a copy of each letter to the Department. If the painted steel components will be recycled by melting, the letter from the recipient is not required. The Contractor shall submit a letter stating the destination of the painted steel components and that they will be melted.

(f) When the work consists of the removal of a bridge or components of a bridge coated with paint which has been assumed to contain lead, chromium, other heavy metals, or a combination thereof the Contractor shall capture paint debris which is dislodged during removal operations. The Contractor may choose any method for dismantling the bridge, subject to the following required construction sequence limitations:

1. The concrete deck shall be removed prior to removal of the steel superstructure.

2. If the methods statement indicates that girders will be dropped to the ground during dismantling, all debris from the concrete deck removal operation shall be removed from the area below the bridge before any girders are dropped into this area.

3. Girders may be cut and dropped only if the span is located entirely over land.

250.05 Material Handling. This work consists of the additional handling of groundwater and soils to be excavated for construction of the project which are suspected or known to be contaminated. This work also includes stockpiling or containerization, analytical sampling and testing, and final disposition of contaminated groundwater and soils requiring special handling.

There is the potential of encountering contaminated groundwater and soil, which has not been summarized in the plans or specifications, at unknown locations on the site. Suspected contaminated soil and groundwater shall be handled as follows:

(a) *Materials Handling (Stockpile& Containerization).* The Beneficial Reuse and Materials Management Plan defines the requirements for reusing soils on site. Health and safety monitoring and strict fugitive dust control shall be conducted during the placement of these soils. If analysis indicates that groundwater samples are designated as uncontaminated, as determined by the

criteria shown in the Contract or as determined by the CDPHE, the groundwater shall be handled in accordance with subsection 107.25.

Stockpiled and containerized materials shall be secured in compliance with the following provisions until they are determined to be uncontaminated:

1. The Contractor shall not store the material for more than 90 days.

2. The Contractor shall prevent any runoff from infiltrating the ground or running out of the containment area.

3. Soils and groundwater containing different contaminants shall be placed in separate containers or stockpiles.

4. The Contractor shall prevent the dispersion of materials or the dilution or mixing of containers and stockpiles.

   The ground surface on which the contaminated soils will be placed shall be covered with plastic sheeting which will withstand the placement and removal of stockpiled materials without breaching. Alternatively, the Developer may place impacted soils, that are not saturated with any contaminant or water, on six inches of clean fill to eliminate the plastic sheeting. Upon final disposition of the stockpile, the six inches must be removed with the stockpile in accordance with the stockpile disposition; however, the disposal of the six inches of soil is considered incidental since it is a means and methods decision and shall not be included in any Supervening Event Submission.

5. The ground surface shall be graded to drain toward the edge of the soil piles and the berm or trench around them shall be covered by plastic sheeting.

6. Proper security shall be provided in accordance with 40 C.F.R..

(b) *Solid Waste Disposal.* Soils determined to be contaminated and not allowed to be reused on the project, but not hazardous, as established by criteria in the Contract or as determined by CDPHE or other regulatory agencies having jurisdiction, shall be handled and disposed of in accordance with all applicable Environmental Laws. The Contractor shall haul this material to a solid waste disposal facility.

(c) *Contaminated Groundwater Disposal.* Groundwater determined to be contaminated as established by CDPHE or other regulatory agencies having jurisdiction, shall be handled and disposed of in accordance with all applicable Environmental Law.

(d) *Hazardous Waste Disposal.* Soils and groundwater that are designated or suspected to be hazardous shall be containerized *immediately* upon excavation or upon discovery. Confirmed Hazardous Waste shall be labeled and transported to a permitted TSD facility or to a hazardous waste disposal facility approved by the Department.

-10-
SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

(e) *Additional Requirements.* Stockpiled or containerized material characterized as uncontaminated, contaminated or hazardous shall be stored and disposed of in a manner consistent with current established federal, state, and local regulations for waste materials.

Materials with contaminants not specifically regulated shall be disposed of by the Contractor as directed, in consultation with CDPHE. All areas where wastes are generated shall be reviewed by the Environmental Manager and HSO to identify potential contaminant sources that may result in a contaminated waste stream.

Contaminated groundwater and soils, which have been identified as solid waste or hazardous waste, requiring disposal according to federal, state, and local regulations, shall be transported in accordance with 49 C.F.R. by the Contractor to an appropriately permitted treatment facility, landfill, incinerator or asphalt plant or other facility approved to accept the waste. CDPHE and the landfill or other treatment or disposal facility shall be notified by the Environmental Manager or HSO of the material to be disposed of and the corresponding analytical test results prior to shipment, if required. Potentially contaminated water collected from the lined trench of a stockpile shall be treated as required by Colorado Wastewater Discharge Permit System (CDPS) permits, 29 C.F.R. and 40 C.F.R..

250.06 Sample delivery. This work consists of the collection, containerization and delivery of material samples for analysis to the testing facility designated in the Contract.

Environmental Protection Agency (EPA) protocol and standards shall be followed in the collection, containerization and transport of samples to be analyzed, including the documentation of the proper chain of custody of all samples. The Contractor shall collect sufficient sample material to perform the required analysis and is responsible for ensuring that appropriate climate control has been provided for sample transport. Sample delivery shall be made within the maximum allowable holding time for each sample type, not to exceed 24 hours, excluding weekends. The time period required for sample collection and delivery to the testing facility will not be considered an excusable delay.

The Contractor shall provide the Department with a copy of documentation indicating that proper chain of custody requirements have been followed for all samples.

The Department may request splits of samples, in advance of collection, which shall be provided at no additional cost by the Contractor.

250.07 Asbestos-Containing Material Management. Known or suspected locations that could involve encounters with ACM during excavation and other soil disturbing construction activities are identified in the (Reference Documents) (Schedule 29). Unexpected discoveries of ACM may be made during excavation and soil disturbing construction activities. When any discarded material is encountered that contains or consists of any of the following: construction, renovation and demolition debris (regardless of how it was generated), building or facility components, components of building systems (HVAC, plumbing, electrical, control, fire protection, roofing), components of pavement or drainage systems, industrial or machinery components, and/or mechanical components from motorized vehicles, the Developer shall conduct inspections in accordance with CDPHE Section 5.5 of the Solid Waste Regulations to determine whether such debris is regulated asbestos contaminated soil. Asbestos contaminated soil, shall be properly managed or remediated, in accordance with subsection 250.07(a) and

the CDOT *Regulated Asbestos Contaminated Soil Management Standard Operating Procedure, dated October 20, 2016.*

All asbestos related activities shall be performed by Colorado certified asbestos professionals, contractors, or consultants. Certifications are issued by the CDPHE, Air Pollution Control Division. An appropriately certified professional shall manage the management and disposal of asbestos contaminated soil and other

ACM. The Air Pollution Control Division within CDPHE is the only unit that certifies such professionals. The Contactor shall furnish a copy of the license to the Department in the Environmental Status Report.

(a) *Regulatory Compliance.* Asbestos-contaminated soil management is governed by 6 CCR 1007-2, Section 5, which includes and references regulatory compliance with Asbestos Hazard Emergency Response Act (AHERA) Colorado *Regulation* 8. Inspection and reporting protocol and demolition standards are governed by AHERA. Demolition and notification standards are governed by National Emission Standards for Hazardous Air Pollutants (NESHAPS). Colorado Regulation 8 governs all asbestos abatement activities on facilities and facility components, demolition, permitting, and certification of Certified Asbestos Professionals in the State of Colorado. Colorado Regulation 8 is more stringent than AHERA and NESHAPS and supersedes federal regulations. Conflicting regulatory requirements between AHERA and NESHAPS, if not specifically addressed in Colorado Regulation 8, shall be addressed and approved protocol negotiated with CDPHE. The Contractor shall conform to all current regulations, policy directives, or both, issued by the EPA, CDPHE, and the Department.

(b) *Asbestos Management and Visual Inspections* Asbestos management must be performed by a certified asbestos professional in accordance with current regulations. Final Inspections of the area of asbestos-contaminated soil removal shall be performed by an appropriately certified asbestos consultant to determine what, if any, controls must be instituted to allow future activity in the excavation area. All final visual inspections shall be conducted only when soil is dry.

(c) *Permitting and Notification.* A 24-hour notification to CDPHE is required within 24-hours of any unexpected discovery of regulated asbestos containing soil during a soil disturbing activity and prior to implementation of CDOT's approved *Regulated Asbestos Contaminated Soil Management Standard Operating Procedure, dated October 20, 2016.* Removal of asbestos-containing material on a facility component, that is located on or in soil that will be disturbed, with asbestos quantities above the following trigger levels must be permitted and abated in accordance with the requirements of Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B):

1. 260 linear feet on pipes,

2. 160 square feet on other surfaces, or

3. The volume of a 55-gallon drum.

All permit applications shall be submitted to the CDPHE a minimum of 10 days prior to start of work for approval. The permit application and notification shall be submitted simultaneously. The Contractor shall obtain all required State and local permits and shall be responsible for all associated fees.

-12-
SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

(d) *CDOT's Regulated Asbestos Contaminated Soil Management Standard Operating Procedure, dated October 20, 2016.* Asbestos contaminated soil shall be managed in accordance with 6 CCR 1007-2, Section 5, Asbestos Waste Management Regulations. The Contractor shall comply with procedures detailed in the CDPHE regulations as specified in 250.07 (a), and CDOT's approved *Regulated Asbestos Contaminated Soil Management Standard Operating Procedure, dated October 20, 2016*, including the following minimum requirements:

1. Immediate actions and implementation of interim controls to prevent visible emissions, exposure, and asbestos contamination in surrounding areas.

2. Soil characterization.

3. Training required for all personnel involved in excavation and other soil disturbing activities, when asbestos discoveries are anticipated, or discoveries are made. Asbestos Awareness Training shall be given by a qualified and Certified Asbestos Building Inspector with a minimum of six months experience inspecting asbestos contaminated soil and who otherwise meets the requirements of current regulations.

4. Assessment for the presence and extent, within the proposed area of disturbance, of potential asbestos discoveries, whether expected or unexpected, by a Certified Asbestos Building Inspector.

5. Investigation and sampling required for risk assessment and management. Investigation, if required, shall be conducted by a Certified Asbestos Building Inspector.

6. Risk assessment and determinations for further management or abatement.

   A. Risk assessment and determinations must be made by a Certified Asbestos Building Inspector.

   B. Soil remediation is not necessarily required, depending on the circumstances.

7. Submit 24-hour Notification of RACS Disturbance.

(e) *Risk Assessment and Determinations for Further Management Or Remediation.* Risk assessment and determinations for further management or remediation must be closely coordinated with the Department.

250.08 Methamphetamine Lab Sites. Demolition of former Methamphetamine (meth) labs is enforced by the Governing Authority, which varies from county to county. The Contractor shall demolish all buildings that are identified as former meth labs, as listed in public listings by the Governing Authority.

-13-
SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

The Contractor shall provide evidence of demolition to the Governing Authority, obtain receipt of such evidence by the Governing Authority, and shall submit these to Department immediately following demolition.

Septic tank removal at known meth lab sites shall undergo preliminary assessment by an Industrial Hygienist or Certified Industrial Hygienist to determine proper removal and disposal. Work shall proceed in accordance with the recommendations of the Hygienist.

APPENDIX

J MANAGEMENT OF STRUCTURES WITH LEAD AND HEAVY METAL PAINT

Standard Operating Procedure

Subject:	Page 1
Management of Structures with Lead and Heavy Metal Paint	April 9, 2019

1.0 PURPOSE

This Standard Operating Procedure (SOP) has been developed to provide an overview for management of structures containing lead, chromium or other heavy metal paint located on the Central 70 (C-70) Project including sign posts, bridge rail, bridges and other structures. Various structures containing lead and heavy metal paint will be disrupted during removal and demolition activities; therefore, special precautions are required to protect workers, the public, and the environment. This SOP outlines the necessary worker safety and environmental protection procedures for compliance with the Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), and Colorado Department of Public Health and Environment (CDPHE) regulations. The Colorado Department of Transportation (CDOT), Central 70 Project Agreement under Section 250 Environmental, Health and Safety Management has additional requirements under 250.04 Heavy Metal Based Paint Management. Paint Removal and Waste Disposal work shall be performed in accordance with 29 CFR 1926.62, State and local air quality regulations, the Steel Structures Painting Council (SSPC) Guide for Containing Debris Generated During Paint Removal Operations, the Industrial Lead Paint Removal Handbook (SSPC 91-18), and the references contained within Subsection 250.4 and 250.03.

Under CDOT Project 250 Specifications, the Contractor shall contact the CDPHE, Air Pollution Control Division to ascertain if an air pollution permit is required for the cleaning or demolition work. If an air pollution permit is required, the Contractor shall obtain the permit and furnish a copy of the permit to the Engineer prior to starting cleaning or demolition activities.

Under OSHA 29 CFR 1926.62, if lead is present in your workplace in any quantity, your employer is required to make an initial determination of whether any employee's exposure to lead exceeds the OSHA action level (30 $\mu g/m^3$ averaged over an 8-hour day). This initial determination requires your employer to monitor workers' exposures unless he or she has objective data which can demonstrate conclusively that no employee will be exposed to lead in excess of the action level.

Your employer is required to develop and implement a written compliance program prior to the commencement of any job where employee exposures may reach the OSHA Permissible Exposure Limit (PEL) as an 8-hour Time Weighted Average (TWA).

2.0 DEFINITIONS

AL Action Level

APR	Air-Purifying Respirator
CDOT	Colorado Department of Transportation
EPA	U.S. Environmental Protection Agency
mg/m^3	milligrams per cubic meter
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
RCRA	Resource Conservation and Recovery Act
TCLP	Toxicity Characteristic Leaching Procedure
TWA	Time Weighted Average
$\mu g/m^3$	micrograms per cubic meter

3.0 OSHA REGULATIONS AND HEALTH HAZARDS ASSOCIATED WITH LEAD AND HEAVY METAL PAINT

Working with lead and heavy metal paint can have adverse health effects to workers, the public and the environment. Lead can be taken into the body by inhalation, ingestion, and by skin absorption in the case of tetraethyl lead. Worker exposure to lead can result in acute and chronic health effects ranging from headaches to dizziness, liver damage, impairment to reproductive systems, nervous system disorders such as anxiety and hyperactivity, and death.

OSHA has established a Lead in Construction Standard under 29 CFR 1926.62 with a PEL of 50 micrograms per cubic meter ($\mu g/m^3$) for an 8-hour TWA and Action Level (AL) of 30 $\mu g/m^3$ for an eight-hour TWA for lead. Compliance with the OSHA requirements is accomplished through the development and implementation of a written compliance program that specifies the practices and procedures to control worker exposure to lead. This SOP has been developed to summarize the work procedures required to meet the OSHA regulations. This SOP should be reviewed and followed by all site personnel performing removal and demolition of structures containing lead paint. This SOP is intended to be used in conjunction with the employer's written compliance program. OSHA has additional regulations with PELs and ALs for cadmium (29 CFR 1926.1127), for hexavalent chromium (29 CFR 1926.1126), for inorganic arsenic (29 CFR 1926.1118) and for other metals that may be contained in painted surface coatings including chromium, mercury, barium, selenium, and silver. See OSHA 29 CFR 1910.1000 Table Z-1 and Table Z-2 for established PELs. For more information, see OSHA 29 CFR 1926 (Construction Industry Standard) and 29 CFR 1910 (General Industry Standard).

4.0 WORK METHODS AND MANAGEMENT OF LEAD AND HEAVY METAL PAINT

For saw cutting, mechanical cutting, grinding, and/or torch cutting on lead containing paint that has not been completely removed, then an initial determination of whether any employee's exposure to lead exceeds the action level (30 ug/m^3 averaged over an 8-hour day). This initial determination requires your employer to monitor workers' exposures unless he or she has objective data which can demonstrate conclusively that no employee will be exposed to lead in excess of the action level. Additional requirements including worker medical surveillance, respiratory protection/personal protective equipment (PPE), worker training, lead hazard work area warning signs, hygiene facilities, record keeping, and protection of the environment are required to comply with the OSHA Lead in Construction regulation. For more information, see the OSHA Lead in Construction Standard 29 CFR 1926.62.

Where construction and demolition operations include removal of structures containing lead and heavy metal paint, the use of a chemical paint stripper can be used to minimize the lead and heavy metal hazard. When a chemical paint stripper is used to completely remove the paint down to bare metal a minimum of four (4) inches on each side of the proposed cuts prior to cutting the structure, then some of the requirements of the OSHA Lead in Construction standard can be reduced. However, an initial determination is still required by the employer to monitor workers' exposures for any lead work of whether any employee's exposure to lead exceeds the action level (30 ug/m^3 for an 8-hour TWA).

5.0 PROTECTION OF THE ENVIRONMENT

During paint stripping or mechanical removal of structures containing lead and heavy metal paint, it will be necessary to place tarps or plastic sheeting under the work area to contain paint chips and debris that may be dislodged during removal structures and components coated with lead paint. After the structural components coated with lead and heavy metal paint have been removed they shall be placed on tarps and cut into transportable sections, then shall be completely wrapped with plastic sheeting and placed on flatbed trucks or loaded into side-walled trailers or lined dumpster, covered with plastic sheeting or tarps, and removed off site.

All paint chips and corrosion residues resulting from removal operations will be containerized, labeled, transported, and disposed of in accordance with all federal, state, and local laws and regulations. Prior to beginning the work, the Contractor shall submit to the Engineer for acceptance, a detailed methods statement for capturing, testing, and disposing of the removed materials. The Engineer will have seven calendar days to review and accept or reject this methods statement.

The site Project Manager, Superintendent or designee will conduct a visual inspection of the work area after the lead work is conducted to ensure that waste materials that escape containment will be collected and placed in drums for disposal. If these protection measures are inadequate, this phase of work will be halted until corrective actions are taken.

All lead and heavy metal containing debris (paint chips, slag, and PPE) shall be collected and stored in approved labeled containers and at a secure location at the site. The painted structures and drummed lead debris will be tested to determine whether it is classified as a hazardous waste. If it meets or exceeds Resource Conservation and Recovery Act (RCRA) criteria for Toxicity Characteristic Leaching Procedure (TCLP) for the eight RCRA metals including lead at 5 milligrams per liter (mg/L), then the material will be required to be transported and disposed of in accordance with U.S. Environmental Protection Agency (EPA) hazardous waste regulations (40 CFR 261).

All painted steel components which are not designated to be salvaged shall be recycled. Contractor possession of the steel for future use shall be considered a form of recycling. Prior to transport of the components off-site, the Contractor shall obtain a letter from the recipients of the painted steel components stating that they have been fully informed of the contents of the paint and are capable of handling the paint. If the Contractor is to maintain future possession of the steel, the Contractor shall supply this letter.

Attachment 6: Central 70 Land Development Permit and Fugitive Dust Plan

COLORADO
Air Pollution Control Division
Department of Public Health & Environment

CONSTRUCTION PERMIT

Permit number: **18AD0991L** **Issuance:** **1**

Date issued: October 22, 2018

Issued to: **Kiewit Infrastructure Co.**

Facility Name: Central 70
Plant AIRS ID: 002/1703
Physical Location: I-25 to Chambers Road
County: Adams
General Description: Land Development

Equipment or activity subject to this permit:

Facility Equipment ID	AIRS Point	Description
-	001	Construct various bridges, reconstruct and widen roads, cross street improvements. Note: This permit does not cover remediation of contaminated soils.

THIS PERMIT IS GRANTED SUBJECT TO ALL RULES AND REGULATIONS OF THE COLORADO AIR QUALITY CONTROL COMMISSION AND THE COLORADO AIR POLLUTION PREVENTION AND CONTROL ACT C.R.S. (25-7-101 et seq), TO THOSE GENERAL TERMS AND CONDITIONS INCLUDED IN THIS DOCUMENT AND THE FOLLOWING SPECIFIC TERMS AND CONDITIONS:

REQUIREMENTS TO SELF-CERTIFY FOR FINAL APPROVAL

1. The particulate emission control measures listed on the attached page (as approved by the Division) must be applied to the particulate emission producing sources as required by Regulation Number 1, III.D.1.b.

2. This permit will expire on July 1, 2022

By: Aaron Moseley
Aaron Moseley
Permit Engineer

Notes to Permit Holder (as of date of permit issuance):

1) The permit holder is required to pay fees for the processing time for this permit. An invoice for these fees will be issued after the permit is issued. Failure to pay the invoice will result in revocation of this permit. The permit holder must pay the invoice within 30 days of receipt of the invoice (Reference: Regulation Number 3, Part A, VI.B.).

2) If this permit specifically states that final approval has been granted, then the remainder of this condition is not applicable. Otherwise, the issuance of this construction permit does not provide "final" authority for this activity or operation of this source. Final approval of the permit must be secured from the Division in writing in accordance with the provisions of 25-7-114.5(12)(a) C.R.S. and Regulation Number 3, Part B, III.G. Final approval cannot be granted until the operation or activity commences and has been verified by the Division as conforming in all respects with the conditions of the permit. Once self-certification of all points has been reviewed and approved by the Division, it will provide written documentation of such final approval. **Details for obtaining final approval to operate are located in the Requirements to Self-Certify for Final Approval section of this permit.**

3) Unless specifically stated otherwise, the general and specific conditions contained in this permit have been determined by the Division to be necessary to assure compliance with the provisions of Section 25-7-114.5(7)(a), C.R.S.

4) Each and every condition of this permit is a material part hereof and is not severable. Any challenge to or appeal of a condition hereof must constitute a rejection of the entire permit and upon such occurrence, this permit must be deemed denied *ab initio*. This permit may be revoked at any time prior to self-certification and final authorization by the Division on grounds set forth in the Colorado Air Pollution Prevention and Control Act and regulations of the AQCC including failure to meet any express term or condition of the permit. If the Division denies a permit, conditions imposed upon a permit are contested by the applicant, or the Division revokes a permit, the applicant or owner or operator of a source may request a hearing before the AQCC for review of the Division's action. (Reference: Regulation Number 3, Part B III.F.)

5) Section 25-7-114.7(2)(a), C.R.S. requires that all sources required to file an Air Pollutant Emission Notice (APEN) must **pay an annual emission fee**. If a source or activity is to be discontinued, the owner must notify the Division in writing requesting a cancellation of the permit. Upon notification, annual fee billing will terminate.

6) Violation of the terms of a permit or of the provisions of the Colorado Air Pollution Prevention and Control Act or the regulations of the AQCC may result in administrative, civil or criminal enforcement actions under Sections 25-7-115 (enforcement), -121 (injunctions), -122 (civil penalties), -122.1 (criminal penalties), C.R.S.

PARTICULATE EMISSIONS CONTROL PLAN

THE FOLLOWING PARTICULATE EMISSIONS CONTROL MEASURES MUST BE USED FOR COMPLIANCE PURPOSES ON THE ACTIVITIES COVERED BY THIS PERMIT, AS REQUIRED BY THE AIR QUALITY CONTROL COMMISSION REGULATION NUMBER 1, III.D.1.b. THIS SOURCE IS SUBJECT TO THE FOLLOWING EMISSION GUIDELINES:

a. **Material Removal Activities -** Visible emissions not to exceed 20% opacity, no off-property transport of visible emissions.

b. **Haul Roads -** No off-property transport of visible emissions must apply to on-site haul roads, the nuisance guidelines must apply to off-site haul roads.

c. **Haul Trucks -** There must be no off-property transport of visible emissions from haul trucks when operating on the property of the owner or operator. There must be no off-vehicle transport of visible emissions from the material in the haul trucks when operating off of the property of the owner or operator.

Control Measures

1. All unpaved roads on site must be graveled and watered frequently to prevent off-property transport of visible fugitive particulate emissions.

2. Vehicle speed on all unpaved roads and disturbed areas must not exceed a maximum of 5 miles per hour. Speed limit signs must be posted.

3. All disturbed surface areas must be watered frequently to prevent off-property transport of visible fugitive particulate emissions.

4. All disturbed surface areas must be seeded with mulch. Revegetation must occur within a year of soil disturbance.

5. Wind brakes made of silt fence must be installed.

6. Gravel entryways and mud mat tracking controls must be utilized to prevent mud and dirt carryout onto paved surfaces. Any mud and dirt carryout onto paved surfaces must be cleaned up daily.

7. Cleanup of paved surfaces with a street sweeper/hose with water must as necessary to prevent off-property transport of visible fugitive particulate emissions..

8. Fencing must be installed prior to overlotting along all property borders that are adjacent to developed areas.

9. Total disturbed area at any one time must not exceed the area declared by the applicant in the permit application.

10. All paving must be completed by **October 1, 2021**.

GENERAL TERMS AND CONDITIONS:

1. This permit and any attachments must be retained and made available for inspection upon request. The permit may be reissued to a new owner by the Division as provided in Regulation Number 3, Part B, II.B upon a request for transfer of ownership and the submittal of a revised APEN and the required fee.

2. This permit is issued in reliance upon the accuracy and completeness of information supplied by the applicant and is conditioned upon conduct of the activity, or construction, installation and operation of the source, in accordance with this information and with representations made by the applicant or applicant's agents. It is valid only for the equipment and operations or activity specifically identified on the permit.

Attachment 7: Community Advisory Group Factsheet

September 2019

Central 70 Project for Construction in OU2

As part of the Central 70 Project, a sanitary sewer line will be installed to connect metro Delgany interceptors to a new line in an existing manhole. The new sanitary sewer line will be installed on the north side of the Denver Coliseum, south of I-70. The pipe is 30 inches in diameter and will be buried roughly 12 feet deep.

The new sanitary sewer line is approximately 400 feet long, a portion of which is within the boundaries of Operable Unit 2 (OU2) of the Vasquez Boulevard and I-70 Superfund site. The work will take about a month to complete. Kiewit has subcontracted with Iron Woman Construction to complete this work.

When the work is occurring, all required precautions will be in place, including the following:

- A Materials Management Plan (MMP) and the Health and Safety Plan (HASP) have been developed specifically for work in OU2. These plans will be followed by the crews and subcontractors completing the work.
- Soil disturbed during the excavation will be handled according to the MMP.
- There will be a Certified Asbestos Building Inspector (CABI) on-site to monitor dirt removal and perform field monitoring for asbestos in soil.
- Dirt removed will be loaded into trucks and covered prior to hauling. Material imported for backfill will meet Environmental Protection Agency (EPA) Regional Screening Levels for use in residential areas.
- All workers at the site will have completed their 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training.
- Construction area perimeter will be fenced.
- Groundwater that may be encountered will be taken to an approved disposal site.
- EPA, Denver Department of Public Health and Environment (DDPHE) and Colorado Department of Public Health and Environment (CDPHE) will review and approve of the MMP prior to operations beginning.

Once the part of the sanitary sewer line through OU2 is complete, crews will continue work on the line, boring much of the remaining pipe. The sewer line will go from this location all the way east to Colorado Boulevard.

Know Before You Go

C70.codot.gov | Central70 to 77948 | 833-C70-INFO | central70info@state.co.us

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Approximate location of the sanitary line under the viaduct along E. 47th Avenue, looking east towards the cattle crossing

Approximate location of the sanitary line under the viaduct along E. 47th Avenue, looking west towards the railroad

septiembre del 2019

Proyecto Central 70 para la Construcción en OU2

Como parte del Proyecto Central 70, se instalará una línea de drenaje sanitario para conectar los interceptores del metro Delgany a una nueva línea en una boca de drenaje existente. La nueva línea de drenaje sanitario se instalará en el lado norte del Coliseo de Denver, al sur de la I-70. El tubo tiene un diámetro de 30 pulgadas y se enterrará aproximadamente a 12 pies de profundidad.

La nueva línea de drenaje sanitario tiene aproximadamente 400 pies de largo, una parte de la cual se encuentra dentro de los límites de la Unidad Operable 2 (OU2) del Bulevar Vásquez y el sitio Superfund de la I-70. El trabajo tomará aproximadamente un mes en completarse. Kiewit ha subcontratado con Iron Woman Construction para completar este trabajo.

Cuando se esté realizando el trabajo, se tomarán todas las precauciones necesarias, incluidas las siguientes:

- Un plan de gestión de materiales (MMP) y el plan de salud y seguridad (HASP) se han desarrollado específicamente para el trabajo en OU2. Estos planes serán seguidos por los equipos y los subcontratistas que completen el trabajo.
- El terreno revuelto durante la excavación se manejará de acuerdo con el MMP.
- Habrá un inspector de construcción de asbestos certificado (CABI) in situ para monitorear la eliminación del terreno y realizar un monitoreo de campo para el asbesto en el terreno.
- La tierra eliminada se cargará en camiones y se cubrirá antes de transportarla. El material importado para el relleno cumplirá con los estándares de Niveles de Evaluación Regionales - Regional Screening Levels de la EPA (Agencia de Protección Medioambiental por sus siglas en inglés) para uso en áreas residenciales
- Todos los trabajadores en el sitio habrán completado su capacitación de 40 horas sobre Operaciones de Desperdicios Peligrosos y Respuesta de Emergencia (HAZWOPER)
- El perímetro del área de construcción estará cercado.
- Si se fuese a encontrar agua subterránea, se llevará a un sitio de eliminación aprobado
- La Agencia de Protección Medioambiental (EPA), el Departamento de Salud Pública y Medio Ambiente de Denver (DDPHE) y el Departamento de Salud Pública y Medio Ambiente de Colorado (CDPHE) revisarán y aprobarán el MMP y el HASP antes de que empiecen las obras.

Una vez que se complete la parte de la línea de drenaje sanitario a través de OU2, las cuadrillas continuarán trabajando en la línea, perforando gran parte de la tubería restante. La línea de drenaje irá desde este lugar hacia el este hasta el Bulevar Colorado.

¡Infórmese Antes de Salir!

C70.codot.gov | ProyectoC70 al 77948 | 833-C70-INFO | central70info@state.co.us

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Ubicación aproximada de la línea de drenaje debajo del viaducto a lo largo de la Ave 47 E, con vista al este hacia el paso de ganado

Ubicación aproximada de la línea de drenaje debajo del viaducto a lo largo de la Ave 47 E, con vista al oeste hacia el ferrocarril