REMEDIAL INVESTIGATION REPORT

EIGHTEEN MILE CREEK SUPERFUND SITE
OPERABLE UNIT 4
NIAGARA COUNTY, NEW YORK

July 2018

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Acronyms and Abbreviations

ºF	degrees Fahrenheit
µg/L	microgram per liter
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	contaminants of potential concern
CSM	conceptual site model
cy	cubic yard
DESA	Division of Environmental Science and Assessment
EPA	United States Environmental Protection Agency
ERT	Environmental Response Team
FS	Feasibility Study
ft	feet
HHRA	Human Health Risk Assessment
IEUBK	Integrated Exposure Uptake Biokinetic
mg/kg	milligrams per kilogram
MS/MSD	matrix spike/matrix spike duplicate
NCP	National Contingency Plan
NYSDEC	New York State Department of Environmental Conservation
No.	number
NPL	National Priorities List
OSWER	Office of Solid Waste and Emergency Response
OU1	Operable Unit 1
OU2	Operable Unit 2
OU3	Operable Unit 3
OU4	Operable Unit 4
oz.	ounce
PCB	polychlorinated biphenyl
ppm	parts per million

QA/QC	Quality Assurance/Quality Control
RI	Remedial Investigation
RSL	Regional Screening Levels
RST 3	Removal Support Team 3
SOP	standard operating procedure
TAL	Target Analyte List
TCL	Target Compound List
XRF	x-ray fluorescence

1.0 Introduction

This Remedial Investigation (RI) Report supports the Feasibility Study (FS) of the Operable Unit 4 (OU4) of the Eighteen Mile Creek Superfund Site (the Site). The United States Environmental Protection Agency (EPA) Region 2 conducted the RI for OU4 through the EPA's Removal Program with the support of Weston Solutions Inc. Removal Support Team 3 (RST 3). This RI Report has been prepared by the EPA and presents the activities and findings of the RI performed at 27 residential properties located adjacent to the former Flintkote Plant (Flintkote) property portion of the Site, located at 300 and 198 Mill Street in Lockport, New York. This RI was prompted by the discovery of Site-related lead contamination in soil on residential properties adjacent to the Flintkote property.

The RI was conducted in cooperation with the New York State Department of Environmental Conservation (NYSDEC).

In March 2013, EPA collected surface soil samples along the east side of Mill Street in Lockport, NY, opposite of the Flintkote property. The surface soil samples were analyzed for lead and polychlorinated biphenyls (PCBs) evaluated as Aroclors, the commercial mixtures referred to collectively as PCBs. Elevated concentrations of lead were found to be present in two of the samples collected. With the development of new analytical tools, EPA collected additional soil samples from the Mill Street properties in October 2016 to determine if the lead found in the soil samples from the previous investigation was related to the Site. The results of the comparative forensic analysis confirmed that the contaminated soil found on the Mill Street residential properties was related to the Flintkote property. As a result, EPA initiated this RI at residential properties adjacent to the Flintkote property to determine the nature and extent of soil contamination.

The 27 residential properties investigated as part of this RI have been assigned unique property identifier numbers (ID No.) to protect privacy.

1.1 Objectives of the Remedial Investigation

The purpose of this report is to document the OU4 RI investigation and results. The work was done in accordance with 40 CFR 300 (the National Contingency Plan (NCP), specifically 300.430(a) (2) and 40 CFR 300.430(d)(1), which provide direction on the execution of RI field activities and preparation of RI report at Superfund sites. The RI report was developed consistent with the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA 1988).

The overall objective of this OU4 RI is to characterize the residential properties east of the Flintkote Property at the Eighteen Mile Creek Superfund Site. Accordingly, the field sampling and data collection activities associated with the investigation will be used to accomplish the following:

- Characterize the nature and extent of contamination in surface soil,
- Conduct a human health and ecological risk assessment to evaluate exposure to soil contamination,
- Identify the physical and chemical characteristics of soil at residential properties, and

- Provide data to support the development and evaluation of remedial alternatives at the Site based on the risk assessment results.

This RI Report was prepared under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), consistent with the National Contingency Plan (NCP) and USEPA Office of Solid Waste and Emergency Response (OSWER) RI/FS guidance (USEPA, 1988).

1.2 Report Organization

This RI Report has been prepared consistent with the USEPA RI/FS guidance (USEPA, 1988) and encompasses the following chapters from this point forward:

- Chapter 2 – Site Background: provides background information about the Site and previous investigations.

- Chapter 3 – OU4 Investigation: describes the various field investigations and studies conducted.

- Chapter 4 – Physical Characteristics: describes the land use.

- Chapter 5 – Nature and Extent of Contamination: identifies the sources of contamination, describes the concentrations, occurrence and distribution of contaminants of potential concern (COPCs) in soil.

- Chapter 6 – Conceptual Site Model: summarizes contaminant sources and release Pathways.

- Chapter 7 – Contaminant Fate and Transport: presents the potential routes of migration, discusses contaminant persistence and the factors that affect the fate and transport of COPCs.

- Chapter 8 – Baseline Risk Assessment: provides a summary of the human health and ecological risk assessments, including descriptions of the receptors and exposure pathways that drive unacceptable human health risk.

- Chapter 9 – Summary of Results: provides the results of the RI.

2.0 Site Background

The Site is located in Niagara County, New York and includes contaminated sediments, soil, and groundwater in and around the Eighteen Mile Creek (Creek).

The headwaters of the Creek consist of an East and West Branch which begin immediately north of the New York State Barge Canal (Canal). Water from the Creek's East Branch originates at the spillway on the south side of the Canal, where it is directed northward underneath the Canal and the Mill Street Bridge through a culvert. Water from the West Branch originates from the dry dock

on the north side of the Canal and then flows northward. The East and West Branches converge just south of Clinton Street in Lockport and then flow north beneath Clinton Street on the former United Paperboard Company (United Paperboard) property. There is a dam located in the Creek behind the United Paperboard building, referred to as the Clinton Street Dam, and the ponded water behind the dam is commonly referred to as Mill Pond. On the former Flintkote Company Plant (Flintkote) property, the Creek splits and forms the Millrace, which is a small segment of the Creek that splits and flows around an area of soil and fill on the Flintkote property, known as the Island. The Creek flows north for approximately 15 miles and discharges to Lake Ontario in Olcott, New York. A Site location map is provided as Figure 1.

EPA has divided the Site into separate phases, or operable units (OUs), for remediation purposes.

- Operable Unit 1 (OU1) addresses the soil contamination at nine residential properties on Water Street and addressed the threats posed from the deteriorating building at the Flintkote property.
- Operable Unit 2 (OU2) addresses the contaminated soil at the following properties: the United Paperboard property, the White Transportation property, the Flintkote property, and Upson Park. OU2 also addresses the contamination within the Creek Channel, which is defined as the sediment within the discrete Creek Corridor section of the Creek; an approximately 4,000-foot segment of the Creek that extends from the Canal to Harwood Street in the City of Lockport. A Creek Corridor overview map is provided as Figure 2.
- Operable Unit 3 (OU3) addresses the contaminated sediments in the Creek that are not addressed by OU2, namely those from the end of the Creek Corridor to its location of discharge into Lake Ontario in Olcott, New York. OU3 also addresses groundwater at the Site.
- Operable Unit 4 (OU4) the subject of this RI, addresses lead-contaminated soil at residential properties located adjacent to the Flintkote property in the City of Lockport, NY.

2.1 History of Operable Unit 4 and the Flintkote Property

The Creek Corridor has a long history of industrial use dating back to the 19th Century when it was used as a source of hydropower. Various manufacturing facilities operated at the properties within the Creek Corridor, including the former Flintkote Company.

The Flintkote property is approximately six acres in size and consists of two adjoining parcels at 198 and 300 Mill Street. The Flintkote property housed many different operations, beginning as a sawmill in the early 1830's. In 1884, the Lockport Paper Company was established at the property. In 1928, the Beckman Dawson Roofing Company purchased the property and began manufacturing felt and felt products. In 1935, the Flintkote Company began production of sound-deadening and tufting felt for installation and use in automobiles. Manufacturing of this product line continued until December 1971, when operations ceased and the plant closed. The disposal history of the site is largely unknown. However, aerial photographs suggest that by 1938, fill was disposed in the section of 300 Mill Street between the Creek and the Millrace in an area known as the Island. The nature of the fill material at that time is unknown. It has been reported that ash resulting from the burning of municipal garbage may have been dumped at the site, which is consistent with the material found on the 198 Parcel and Island.

2.2 Previous Investigations

The results of previous historical investigations conducted by NYSDEC at the OU1 Water Street residential properties in the City of Lockport, NY, indicated that the properties were contaminated by fill material containing PCBs and metals, and may also be further contaminated by periodic flooding of the Creek. In March 2013, EPA performed an RI at OU1 to supplement the investigation performed by NYSDEC. As part of the OU1 RI, EPA collected a total of nine additional surface soil samples in the backyards of some Jackson Street properties, in addition to sampling the public right-of-ways along Mill Street opposite of the Flintkote property. Four samples were collected on Jackson Street, and the analytical results of these four samples did not reveal elevated levels of PCBs or metals indicative of Site-related impacts. On Mill Street, five soil samples were collected near the public right-of-way of two residential properties. Analytical results of these five soil samples did not reveal elevated levels of PCBs. However, lead was detected in all five Mill Street soil samples, and two out of the five Mill Street soil samples revealed lead concentrations ranging from 420 parts per million (ppm) to 470 ppm.

In June 2013, EPA conducted a second sampling event in accordance with the *Superfund Lead-Contaminated Residential Sites Handbook* (USEPA 2003) at the two properties with elevated lead levels to evaluate whether the concentrations are representative of the lead concentrations in soil at these properties. The results of the June 2013 sampling showed average concentration of lead in the surface soil at one of the properties exceeded 400 ppm. The analytical results for the 2013 sampling are available as part of the Administrative Record for OU1.

3.0 OU4 Investigation

3.1 Sampling Approach

The RI for OU4 included surface soil sampling (0 to 2 feet) at 27 residential properties completed in three separate phases during the Summer and Fall of 2017. EPA began sampling in July 2017, starting with 9 residential properties located east of the Flintkote property to determine if any additional properties have been impacted by the Flintkote portion of the Site. The Phase One residential properties were located on Mill Street, Porter Street, and Chapel Street in Lockport, NY. Based on the results of the Phase One sampling, EPA determined it was necessary to expand the investigation to include an additional 8 residential properties along Porter Street and Frost Street. Based on sampling results from Phase Two, EPA expanded the investigation to include an additional 10 residential properties along Frost Street, Porter Street, and North Adams Street. One property was not sampled due to refusal for access. For privacy reasons, unique property ID Nos. have been assigned to each of the investigated properties to protect privacy. A map of the 27 residential properties and their property ID Nos. is provided as Figure 3. The investigation spanned three phases as follows:

Phase	Dates	Property ID No.	Focus of Investigation
I	July 17–19, 2017	P002, P003, P004, P005, P021, P022, P023, P024, P025	Surface Soil (0 to 2 feet)
II	September 18–21, 2017	P026, P027, P028, P029, P030, P031, P032, P033	Surface Soil (0 to 2 feet)
III	November 13–17, 2017	P034, P035, P036, P037, P038, P039, P040, P041, P042, P043	Surface Soil (0 to 2 feet)

In order to define the full extent of contamination, a fourth phase of sampling was conducted during the development of this RI. The sampling results of the additional properties are not included as part of this document and will be added as an addendum to this RI.

3.2 Field Sampling Methods

Due to the nature and extent of contamination at the Flintkote property, the Chemicals of Potential Concern (COPCs) selected for OU4 include lead, PCBs, and antimony, which are the same as the COCs at the Flintkote property at OU2. The soil sampling parameters at the OU4 residential properties initially included PCBs analyzed and evaluated as Aroclors, antimony, lead, and full target analyte list (TAL) metals, including tin, to support the forensic analysis data needs.

In order to analyze the samples for PCBs and TAL metals, the Phase One samples were collected as discrete grab samples. The Phase One grab samples were submitted to a laboratory and analyzed for PCBs and full TAL metals, including tin. Phase One analytical results did not reveal elevated levels of PCBs, therefore, EPA determined it was not necessary to sample for PCBs in Phase Two and Phase Three. Because PCBs were no longer being analyzed, EPA used a five-point composite sampling method for Phase Two and Phase Three in accordance with the *Superfund Lead-Contaminated Residential Sites Handbook.* Phase Two and Phase Three soil samples were submitted to a laboratory and analyzed for full TAL metals, including tin.

3.3 Summary of Sampling Activities

Prior to each sampling event, all locations of subsurface utilities at each of the 27 properties were marked out following a utility mark-out request submitted by RST 3 to the New York 811 Dig Safe Program to identify subsurface utilities within the proposed investigation areas.

On July 17, 2017, RST 3 mobilized to the Site to perform the sampling event. On July 18 through July 20, 2017, RST 3 collected a total of 163 soil samples, including Quality Assurance/Quality Control (QA/QC) samples, from the nine Phase One properties. The soil samples were submitted to a laboratory for PCB analysis and TAL metals, including tin.

On September 18, 2017, RST 3 mobilized to the Site to perform the sampling event. On September 19 through September 21, 2017, RST 3 collected a total of 147 composite soil samples, including QA/QC samples, from eight residential properties. The samples were submitted to a laboratory and analyzed for TAL metals, including tin.

On November 13, 2017, RST 3 mobilized to the Site to perform the sampling event. On November 14 through November 16, 2017, RST 3 collected a total of 121 composite soil samples, including QA/QC samples, were collected from ten residential properties. The samples were submitted to a laboratory and analyzed for TAL metals, including tin. A summary of sampling activities can be found in Table 1.

3.3.1 Phase One Sampling Methodology

All field work was performed in accordance with the RST 3 *Site-Specific Health and Safety Plan* (HASP), the RST 3 *Site-Specific Quality Assurance Project Plan* (QAPP), and EPA's Emergency Response Team (ERT)/Scientific, Engineering, Response & Analytical Services (SERAS) contractor Standard Operation Procedures (SOPs) Number (No.) 2001: *General Field Sampling*

Guidelines and SOP No. 2012: *Soil Sampling.* At each property to be sampled, six soil boring locations were selected and marked using survey flags, except for Property P023, where three soil boring locations were selected due to the size of the property.

At each soil boring location identified on each property, soil borings were advanced using nondedicated stainless steel hand augers. Grab soil samples were collected from depths 0 to 2 inches, 2 to 6 inches, 6 to 12 inches, 12 to 18 inches, and 18 to 24 inches, below ground surface (bgs) using dedicated plastic scoops and placed into dedicated plastic Ziploc® bags. Organic debris was removed from each bagged sample before being homogenized. Fresh nitrile gloves were donned between sampling intervals and boring locations. All soil samples were screened on-site for lead using a Niton XL3t® portable x-ray fluorescence (XRF) analyzer equipped with a portable test stand and radiation shield. Each soil sample was screened three times using a screening interval of approximately 30 seconds. The three screening results were then averaged to determine the total lead concentration. The XRF screening results are included as Table 4.

Soil samples collected at each property from depths 0 to 2 inches and 18 to 24 inches bgs were selected for laboratory analyses. Upon reviewing the lead screening results for the soil samples collected from depths 2 to 6 inches, 6 to 12 inches, and 12 to 18 inches bgs at each property, the depth interval with the highest screening result for lead at each soil boring was selected for laboratory analyses. The selected soil samples were then transferred from the plastic Ziploc® bags into 8-ounce (oz) sample jars. Field duplicates and matrix spike/matrix spike duplicates (MS/MSD) were collected at a rate of at least one per 20 field samples.

Decontamination of non-dedicated sampling equipment (*i.e.*, stainless hand augers) was conducted in accordance with EPA's ERT/SERAS contractor SOP No. 2006: *Sampling Equipment Decontamination*, and was performed between sampling intervals and locations, and consisted of a soap (Alconox®) solution scrub and potable water rinse. In order to demonstrate adequate decontamination of non-dedicated sampling equipment, a rinsate blank was collected at the end of each sampling day by pouring de-ionized water over a decontaminated stainless-steel hand auger. The rinse water was collected into sample bottles.

All sample information was entered into the EPA Scribe data management system from which sample labels and Chains of Custody Record were generated. The sample labels were affixed to the soil sample jars and rinsate sample bottles and then preserved on ice in coolers. Sample location coordinates were collected using GPS technology. After sampling was completed at each property, the soil borings were backfilled with the originally removed soil in reverse order. In the event that additional soil was needed to properly backfill the borehole, top soil purchased from a hardware store was utilized in order to return the boring locations to their pre-sampling conditions.

3.3.2 Phases Two and Three Sampling Methodology

All field work was performed in accordance with the RST 3 Site-Specific HASP, the RST 3 Site-Specific QAPP, and EPA's ERT SERAS contractor SOP No. 2001: *General Field Sampling Guidelines* and SOP No. 2012: *Soil Sampling.* At each property to be sampled, the area of concern (AOC) was divided into sampling quadrants of approximately equal surface area. The number of quadrants and sample locations at each property were determined by the size of the property and

marked using survey flags. Soil sampling was conducted following the guidelines provided in the EPA *Superfund Lead-Contaminated Residential Sites Handbook.*

Soil borings were advanced manually using non-dedicated stainless-steel hand augers to a depth of two feet bgs at each selected location. Five-point composite soil samples were collected from five discrete depth intervals (0 to 2 inches, 2 to 6 inches, 6 to 12 inches, 12 to 18 inches, and 18 to 24 inches bgs) within each sampling quadrant and composited into one sample for each specific interval. The soil samples were collected from the stainless-steel hand augers using dedicated plastic scoops and placed in re-sealable plastic bags. Organic debris was removed from each bagged sample before being homogenized and then placed into 8 oz. glass sample jars. Fresh nitrile gloves were donned between sampling intervals and boring locations. Using this sampling method, five composite soil samples from five discreet depth intervals were collected from each sample quadrant at each property.

The soil samples were sieved by the laboratory using 150 μm sieve prior to analysis. Field duplicates and MS/MSD were collected at the rate of one per 20 field samples or one per property, whichever was less. In order to demonstrate adequate decontamination of non-dedicated sampling equipment (*i.e.* stainless hand augers), a rinsate blank was collected at the end of each sampling day by pouring laboratory grade de-ionized water over a decontaminated stainless-steel hand auger. The rinse water was collected into sample bottles. Decontamination of non-dedicated sampling equipment (*i.e.*, stainless steel hand augers) was conducted in accordance with EPA's ERT/SERAS contractor SOP No. 2006: *Sampling Equipment Decontamination*, and was performed between sampling intervals and locations, and consisted of a soap (Alconox®) solution scrub and potable water rinse.

All sample information was entered into the EPA Scribe data management system from which sample labels and Chain of Custody Record were generated. The sample labels were affixed to the soil sample jars and rinsate sample bottles and then preserved on ice in sample coolers. RST 3 performed photographic documentation of the Site conditions and notation in a Site logbook of Site activities throughout the Removal Assessment. Sample location coordinates were documented using GPS technology. After sampling was completed at each property, the soil borings were backfilled with the originally removed soil in reverse order. In the event that additional soil was needed to properly backfill the borehole, top soil was utilized in order to return the boring locations to their pre-sampling conditions.

3.4 Background Investigation

In October 2016, surface soil samples were taken from Dolan Park in Lockport, NY in order to establish background levels from an area with the same physical, chemical, geological, and biological characteristics as the OU4 soils, but has not been influenced by the releases from the Site. Dolan Park is located approximately six blocks southeast of the OU4 area, and consists of a large open grassy area. The samples were collected EPA Region 2 ERRD and were analyzed by the EPA Region 2 Division of Environmental Science and Assessment (DESA) laboratory for TAL metals. The concentrations of lead in background soil samples ranged from 17 ppm to 36 ppm. A forensic study sample location map showing the background location is provided as Figure 4. Soil sample analytical results for background soils are provided in Table 5 and in Appendix F.

4.0 Physical Characteristics

4.1 Residential Property Information

All the properties encompassed in OU4 are residential properties of varying sizes. Most of the homes were built in the early 20th century, and the earliest home was built in the 1880s. Approximately twenty of the homes are single-family, six are multi-family homes, and there is one vacant property with an uninhabitable house. The majority of the properties have yards with grass cover and landscaping, a driveway, and sidewalks. Several of the properties have small gardens used for growing vegetables, others have flower gardens. Most of the homes have one or more large trees of a variety of species. There are at least two properties with above-ground pools. The topography at the residential properties is generally flat, and the Flintkote property on Mill Street dips toward Eighteen Mile Creek. A map of the OU4 area is provided as Figure 1.

4.2 Geology and Soil

Soil types in the surrounding area of the OU4 residential properties include gravelly loam and sun silt loam. During sampling activities, fill material was encountered in some of the borings, which included various types of dark brown soil and fill, concrete, red brick, coal ash and coal fragments.

The OU4 residential properties are located adjacent to the Flintkote property, which is part of OU2. Overburden deposits throughout OU2 consist of mostly glacial tills and lacustrine silts and clays with localized areas of fill material overlying bedrock. Overburden also includes areas where massive pieces of bedrock are believed to have been backfilled with stone, masonry material, brick and other waste. Subsurface investigations at the Flintkote property completed as part of the OU2 RI revealed a thin topsoil layer overlying fill that consists of various colored ash with glass, coal, coke, slag, buttons, ceramic, and brick. Glacially deposited native soil consisting of fine grained silts and clays underlie the fill in most areas followed by bedrock. Sample borings revealed a mixture of sand, gravel, silt and clay containing pieces of slag and black sandy fill. Additional possible fill was observed consisting of gray clay-matrix material containing varying proportions of unsorted sand and fine gravel. The color of the sand and gravel varied between black, gray, brown, tan, red, yellow, and more (EEEPC 2017).

4.3 Demography and Land Use

OU4 includes 27 residential homes, and the residents' ages range from young children to retirement age adults. No commercial or industrial development is present within the boundary of OU4. However, there is industrial/commercial land use on Mill Street adjacent from OU4, as well as commercial land use along Frost Street adjacent to OU4.

As of 2010, the total population of Niagara County was 216,469 people, with the greatest densities in the City of Lockport and Niagara Falls. The percentage of the population under 18 years is 21.5% while 15.9% of the population is aged 65 years and over. The racial makeup in the region is dominated by Caucasians – nearly 90% of the population is white. The majority of individuals over the age of 25 have high school educations or better, and around 10% have a Bachelor's degree or higher level of education. In 2010, the median household income in Niagara County was approximately $49,091 compared with Erie County's median household income of $41,967. The

percentage of the population living below poverty in Niagara County was 9.9% in 2010 (EEEPC 2017).

Land use in the Eighteen Mile Creek watershed is primarily of cropland and orchards, with residential, commercial, and industrial areas located in and around Lockport, Newfane, and Olcott Harbor. The city of Lockport is the most densely populated area within the watershed. (EEEPC 2017).

5.0 Nature and Extent of Contamination

5.1 Approach to the Evaluation of Contamination

The evaluation of the nature and extent of contamination at OU4 focuses on several Contaminants of Potential Concern (COPC), which were selected by reviewing data collected during this RI as well as historic data from OU1 and OU2. Historical Site practices at the Flintkote property were also taken into consideration. Data collected during this OU4 RI were compared to regulatory screening criteria and background sampling results to evaluate the spatial distribution of contamination.

The COPCs selected for OU4 include lead, PCBs, and antimony, which are the same as the COCs for OU2. The Human Health Risk Assessment (HHRA) evaluation that resulted in the designation of lead as the primary COPC is summarized in HHRA in Section 8 below.

5.2 Regulatory Screening Criteria

PCBs

The New York State 6-NYCRR Part 375 Protection of Residential Use Soil Cleanup Objective (SCOs) for PCBs is 1 ppm, which is an ARAR, a TBC, or an 'other guidance' to consider in addressing contaminated soil at residential properties.

Other Contaminants

Soil sampling analytical results were compared to New York State 6-NYCRR Part 375 SCOs to assist in the interpretation of the nature and extent of soils contaminated with TAL metals, excluding lead, which is further described below.

Lead

The New York State 6-NYCRR Part 375 Protection of Residential Use SCO for lead is currently 400 ppm, which is an ARAR, a TBC, or an 'other guidance' to consider in addressing contaminated soil at residential properties.

EPA OSWER Directive 9355.4-12 (1994) identifies a residential soil screening value of 400 ppm to determine if additional investigation is needed at sites with lead contaminated soil. This screening level was derived using the Integrated Exposure Uptake Biokinetic (IEUBK) model with a target blood lead level of 10 µg/dL, consistent with the CDC blood lead action level at that time. As provided in the December 2016 OLEM Directive 9200.2-167, however, recent toxicological

studies suggest that adverse health effects are associated with blood lead levels less than 10 µg/dL in children; specifically, with mean blood lead levels between 2 and 8 µg/dL (EPA 2016b). In support of such findings, an average concentration of 200 ppm was selected, in consultation with the EPA Lead Technical Review Workgroup, to reflect IEUBK modeling results based on a target blood lead level of 5 µg/dL.

5.3 Discussion of Laboratory Analytical Results

The validated analytical results of the 27 residential properties varied between properties and no distinct pattern of contamination was observed. The results indicated a wide range of lead concentrations from 11 ppm to 1,610 ppm, which may indicate the presence of hot spots. Many of the properties showed lead contamination in the surface soil from 0-2 inches and 2-6 inches above background levels found at Dolan Park. Most of properties also showed elevated concentrations of lead contamination in the subsurface soil from 6-18 inches, which is indicative of fill material believed to be related to the Site. The analytical results for the 27 properties sampled as part of this RI are provided in Tables 2 and 3. Soil sampling results are also shown in the residential property maps as Figure 5.

The validated analytical results of the soil samples collected from the nine Phase One properties showed slightly elevated concentrations of lead ranging from concentrations of 27 ppm to 1,340 ppm. Sample P022-S006-0612-01, which was collected at 6 to 12 inches bgs from Property P022, indicated the highest concentration of lead at 1,340 ppm. One property (P025) showed low concentrations of PCB Aroclors 1248 (0.12 ppm), 1254 (0.15 ppm) and 1260 (0.62 ppm), which are below the screening level of 1 ppm.

The validated analytical results of the soil samples collected from the eight Phase Two properties indicated slightly elevated concentrations of lead at each of the eight properties sampled. Concentrations of lead ranged from 37 ppm to 1,400 ppm. Sample P030-S002-0612-01, which was collected at 6 to 12 inches bgs in quadrant 2 of Property P030, indicated the highest concentration of lead at 1,400 ppm.

The validated analytical results of the soil samples collected from the ten residential properties in Phase Three indicated slightly elevated concentrations of lead at nine of the ten properties sampled during the sampling event. Concentrations of lead ranged from 11 ppm to 1,610 J (estimated result) ppm. Sample P040-S002-0612-01, which was collected at 6 to 12 inches bgs in quadrant 2 of Property P040, indicated the highest concentration of lead at 1,610 J (estimated result) ppm.

The findings of this RI may not delineate the full extent of contamination, therefore, additional sampling at surrounding properties may be necessary. In June 2018, EPA targeted additional properties for soil sampling to delineate the full extent of contamination, and the results of the sampling will be added as an addendum to this RI.

6.0 Conceptual Site Model

Due to historic practices at the Flintkote property and confirmed by a forensic evaluation, EPA determined that the OU4 area was contaminated with lead from the Flintkote property. It is unclear how the lead migrated from the Flintkote property to the residential properties, however, EPA believes fill material from the Flintkote property may have been used at residential properties in the OU4 area to bring properties to grade. Historical aerial photographs of the OU4 area were evaluated to determine whether there was any evidence of historical fill deposited at the residential properties. However, only a limited number of photographs were available during the time the homes were built or may have been altered with fill material. The available photographs did not show any evidence of physical disturbance.

A forensic evaluation of the OU4 area determined the contamination found at the OU4 residential properties corresponds with the contaminated waste material found on the Flintkote property during a 2016 sampling event. The forensic evaluation is further described in Section 7.2.

7.0 Contaminant Fate and Transport

This chapter describes the fate and transport processes that influence the persistence and migration of the COPCs at the Site. The major sections of this chapter cover general fate and transport considerations for the COPCs, the forensic analyses of current and historical COPCs and their likely sources. As described in Section 5.1, the COPCs include lead, PCBs, and antimony based on the OU assessments for the Flintkote Property.

7.1 Potential of Migration

Contaminated soil at the residential properties is not expected to migrate off-site due to the amount of grass and other native vegetation which naturally keeps the soil in place. Lead has a higher affinity to bond with soil particles and is generally is retained in the upper layers of soil and is not expected to leach into the subsoil or groundwater. The contamination is primarily located in the top two feet of soil, therefore, impacts to groundwater are not anticipated.

7.2 Forensic Evaluation

In October 2016, EPA collected additional samples from known contaminated areas of the Flintkote property for forensic comparison to the lead found in soil on the residential properties to further evaluate whether the soil contamination was attributable to the Site. The forensic analysis was conducted by EPA's Division of Environmental Science and Assessment (DESA) through plotting and evaluating distributional patterns of elevated metals concentrations in soil above background levels from the former Flintkote plant area to assess source impacts to soil in surrounding residential properties. The samples were analyzed for full TAL metals, including tin, to support the forensic analysis data needs. This evaluation revealed that 11 metals exhibited distinct distributional patterns of metals concentrations that could be used as a "fingerprint" to attribute elevated lead concentrations to former site activities. The concentrations patterns of these metals in residential soils were then compared to these same metals concentrations in the former Flintkote plant area soils. Residential soil patterns that matched were attributed to former site activities. Any questionable or partial matches were conservatively ascribed to past Site activities.

The results of the evaluation demonstrated that the soil contamination at the OU4 residential properties was likely attributable to the Flintkote property portion of the Eighteen Mile Creek Site. A forensic study sample location map is provided as Figure 4. Data used to support the forensic evaluation is provided in Table 5 and in Appendix F. Forensic sample collection information is provided in Table 6.

8.0 Baseline Risk Assessments

As part of the RI/FS for OU4, risks to human health and ecological receptors from OU4 related contamination were evaluated. The Human Health Risk Assessment (HHRA) document can be found as Appendix C to this RI. The results of the HHRA and the ecological risk review is summarized below and this information will be used to support decisions on the Site.

8.1 Human Health Risk Assessment

The HHRA evaluates cancer risks and non-cancer health hazards from exposure to COPCs, which include PCBs, antimony, and lead. The HHRA evaluates current and future risks under baseline conditions, which means in the absence of any remedial action and institutional controls. The HHRA uses current EPA policy and guidance (EPA 1989, 1990a,b, 1992a,b, 194a,b, 1995, 2001, 2002a,b, 2003a,b, 2004 a,b, 2005 a,b, 2007, 2014, 2015a,b, 2016, 2018, and OLEM Directive 9200.2-177, 2016).

8.1.1 Data Evaluation

The full dataset, provided in Appendix E, met all appropriate quality assurance and quality control requirements, and is appropriate for use in the assessment.

8.1.2 Toxicity Information

The toxicity assessment determines the relationship between the magnitude of exposure to a COPC and the nature and magnitude of adverse health effects that may result from such exposure. COPCs are classified into two categories: carcinogens and noncarcinogens.

Toxicity criteria have been selected according to the OSWER Directive 9285.7-53 (USEPA, 2003), which recommends a hierarchy of human health toxicity values for use in risk assessments at Superfund sites. A table summarizing cancer slope factors (CSFs) and reference doses (RfDs), target organ, weight of evidence classifications, uncertainty factors, and other relevant information for each COPC is provided in the HHRA.

8.1.3 Risk Characterization

For each COPC, EPA calculated potential exposures using standard default exposure assumptions. Potential exposure routes included ingestion of, dermal contact with, and inhalation of particles from surface soil. Exposures were evaluated under assumptions of reasonable maximum exposure (RME). The RME is the highest exposure reasonably expected to occur to a resident of the properties in the absence of institutional controls or remedial actions.

The HHRA found:

- Non-cancer hazards from exposure to PCBs and antimony on the individual properties were both below the Hazard Quotient (HQ) of 1, which meets the goal of protection for noncancer exposures for the individual chemicals.
- Cancer risks from exposure to PCBs were below health protective screening levels on all properties with one exception. The soil concentrations on this property were further evaluated in the HHRA, and the risks were within the acceptable risk range of one in a million to one in ten thousand established under the NCP.

8.1.4 Lead

A different approach was used for the COPC lead, in accordance with EPA guidance. Evidence suggests that adverse health effects can occur due to low exposures to lead, particularly in young children. Consequently, lead is evaluated based on the extensive research regarding the chemicals' toxicokinetics (absorption, metabolism, and excretion). EPA regulates lead based on estimated acceptable blood lead levels (PbBs). Lead hazards are only evaluated for children, as children younger than six years are the most susceptible to lead exposure.

For OU4, EPA evaluated the lead hazard based on the average concentration of lead in soil to a depth of 2 feet on the individual properties. To estimate the potential PbB from soil exposure, the IEUBK model was run using the average concentration of lead in soils from each individual property. The calculated PbB was then compared to the acceptable PbB concentration of 5 micrograms per deciliter in blood(ug/dL). As described in Section 5.2, EPA issued OLEM Directive 9200.2-167, dated December 22, 2016, that indicates a PbB of 10 micrograms/deciliter (ug/dL) is no longer considered health-protective. Current scientific information indicates that adverse health effects are evident with PbB between 2 and 8 ug/dL. In support of such findings, an average lead concentration of 200 ppm was selected for delineating nature and extent in the RI, which reflects IEUBK modeling results based on a target blood lead level of 5 µg/dL. This is consistent with EPA's risk reduction goal for the Site, which is to limit the probability of a child's PbB exceeding 5 µg/dL to 5% or less.

The IEUBK model predicted that under residential exposure assumptions (e.g., young child exposed 350 days/year for 6 years), receptors at the residential properties would have PbBs greater than 5 ug/dL.

8.2 Ecological Risk Assessment

In residential areas, EPA expects the main purpose of these properties is for human residential use and activities, and thus ecological function is not considered a primary goal for the area. While portions of the residential properties may have limited ecological function (e.g. used sporadically as a feeding area by wildlife), the expected ecological function is related to aesthetics for human use rather than primarily for ecological benefit. Further, these soils do not represent secondary sources of contamination because contaminant migration to ecological areas of concern (the Eighteen Mile Creek) is not expected. Therefore, further assessment of ecological risk for these properties is not required.

8.3 Risk Assessment Summary and Conclusions

The HHRA found the cancer risks and non-cancer hazards from exposure to PCBs and antimony were within the risk range for PCBs and below the goal of protection of an HQ = 1 for the other metals.

The HHRA calculations using the IEUBK model for lead determined that exposure to lead in residential surface soils may result in PbBs greater than 5 µg/dL, which presents an unacceptable risk to human health and warrants the need for remedial action.

9.0 RI Summary and Conclusions

Forensic analytical tools were used to identify chemical patterns in samples that allow comparisons to potential sources of contamination. EPA collected additional soil samples in October 2016 at the Mill Street residential properties and the Flintkote property for forensic comparison. The forensic analysis confirmed the contaminated soil found on the Mill Street residential properties is related to the Flintkote property.

In July 2017, using a phased approach, EPA conducted additional soil sampling in July, September, and November 2017. The results of the soil sampling at the 27 residential properties showed generally shallow lead contamination at varying concentrations with no distinct pattern of distribution. The results indicated lead concentrations ranges from 11 ppm to 1,610 ppm. Many of the properties showed slightly elevated levels of lead contamination in the surface soil from 0-2 inches and 2-6 inches. Most of the properties also showed elevated concentrations of lead contamination in the subsurface soil from 6-18 inches, which is indicative of fill material believed to be related to the Flintkote property.

The analytical results of this RI show that 26 of 27 properties had concentrations of lead in soil above 400 ppm, or an average concentration of lead greater than 200 ppm used to achieve a target PbB of 5 µg/dL, as described in Sections 5.2. and 8.1.4. Based on the findings of the HHRA, a remedial action is warranted at these residential properties. The findings of this RI may not delineate the full extent of contamination, therefore, additional sampling at surrounding properties may be necessary. In June 2018, EPA targeted additional properties for soil sampling to delineate the full extent of contamination, and the results of the sampling will be added as an addendum to this RI.

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List of Appendices