United States Steel Corporation
Fairfield, Alabama
EPA I.D. Number ALD 002 904 506

FACT SHEET

A draft modification of the Alabama Hazardous Waste Management and Minimization Act (AHWMMA) permit has been prepared for the United States Steel Corporation (U.S. Steel) facility. This hazardous waste facility is located in Fairfield, Alabama. This fact sheet has been prepared to briefly advise the public of the principal permitting, legal and policy issues of the draft permit.

I. PERMIT PROCESS

The purpose of the permitting process is to allow the State and the public to evaluate U.S. Steel's ability to comply with the hazardous waste management requirements of the AHWMMA, as amended. U.S. Steel must comply with hazardous waste management conditions set forth in the permit during the effective period of the permit, which is ten (10) years from the last permit renewal (September 17, 2019).

II. PROCEDURES FOR REACHING A FINAL DECISION

The Alabama Department of Environmental Management (ADEM or Department) is proposing to issue U.S. Steel a permit modification for the post-closure permit.

ADEM Admin. Code r. 335-14-8-.08(6)(b)1. requires that the public be given at least a 45-day comment period for each draft permit. The comment period will begin on October 22, 2021, which is the date of publication of the public notice in major local newspaper(s) of general circulation, and will end on December 6, 2021. The public notice will also be broadcast over local radio station(s).

Any person interested in commenting on the application or draft permit must do so within the 45-day comment period discussed above.

All persons wishing to comment on any of the permit conditions or the permit application should submit their comments in writing to the Alabama Department of Environmental Management, Permits and Services Division, 1400 Coliseum Blvd. (zip 36110-2059), P.O. Box 301463 (zip 36130-1463) Montgomery, Alabama, ATTENTION: Mr. Russell A. Kelly.

ADEM will consider all written comments received during the comment period while making a permit decision for this facility. When the Department makes its final permit decision, notice will be given to the applicant and each person who has submitted written comments or requested notice of the final permit decision.

III. FACILITY DESCRIPTION

U.S. Steel is a facility that operated an integrated iron and steel-making facility and began operations in 1917. The facility includes the Fairfield Works former steel manufacturing plant, a former coke plant, the Exum Materials Management Area, the Ensley Plant (former coke and iron production plant), an oil recycling facility, several mines, a municipal landfill, and other miscellaneous land. Subunit 5 of impoundment D-6 was used to consolidate contaminated material during the closure of units S-20 and D-6 and was closed as a landfill. These actions are intended to mitigate the potential for future groundwater contamination. The permit also addresses corrective action for Solid Waste Management Units (SWMUs).

IV. SUMMARY OF PROPOSED MODIFICATIONS

This proposed modification addresses the revisions to the permit and permit application for the incorporation of the Corrective Measures Implementation Plan for SWMU 23, which is the Exum Materials Management Area.

V. CHANGES TO THE EXISTING PERMIT

The specific changes to the permit are explained below.

Section/Appendix	**Reason**
Permit Cover Page	Updated major modification date
Permit Signature Page	Updated major modification date
Permit Table of Contents	Updated major modification date
Part III. Groundwater Monitoring and Corrective Action	Modified Part III.B, Part III.E, Table III.1, and Table III.3 to incorporate SWMU 23 (Exum) groundwater monitoring program
Part IV. Solid Waste Management Unit Identification and Evaluation	Updated Table IV.1 to indicate RFI for SWMU 23 (Exum) is complete
Part V. Corrective Measures Implementation	Updated CMS/CMI table in Permit Condition V.B.1 and Table V.1 to incorporate the SWMU 23 (Exum) CMI Plan

VI. TECHNICAL CONTACT

Tamaria L. McAlpin
Engineering Services Section
Industrial Hazardous Waste Branch, Land Division
Alabama Department of Environmental Management
1400 Coliseum Blvd (zip 36110-2059)
P.O. Box 301463 (zip 36130-1463)
Montgomery, Alabama
(334) 274-4188

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
HAZARDOUS WASTE PERMIT

Permittee:

OWNER:
United States Steel Corporation
P.O. Box 599
Fairfield, Alabama 35064
Jefferson County

OPERATOR:
U.S. Steel Fairfield Works
5700 Valley Road
Fairfield, Alabama 35064
Jefferson County

Permit Number: ALD 002 904 506
Identification Number: ALD 002 904 506

Pursuant to the Alabama Hazardous Wastes Management and Minimization Act (AHWMMA), Code of Ala. 1975, Section 22-30-1, et. seq., as amended, and attendant regulations promulgated thereunder by the Alabama Department of Environmental Management (ADEM or the Department), a permit is issued to United States Steel Corporation for the facility located in Fairfield, Alabama, at latitude N 33° 28' 30" and longitude W 86° 50' 00".

The Permittee must comply with all terms and conditions of this permit, which consists of the conditions set forth herein (including those in any attachments), and the regulations applicable to the Permittee's facility contained in Chapters 335-14-1, 335-14-2, 335-14-5, 335-14-8, and 335-14-9 of the ADEM Administrative Code of Regulations (hereinafter referred to as the "ADEM Admin. Code Rule"). Applicable regulations are those which are in effect on the date of issuance of this permit.

This permit is based on the assumption that the information submitted in the permit application attached to the Permittee's letter dated December 17, 2018, as modified by subsequent amendments dated April 30, 2019, May 31, 2019, and July 27, 2021(hereby incorporated by reference and hereafter referred to as the Application) is accurate and that the facility will be constructed and operated as specified in the Application. Any inaccuracies found in this information could lead to the termination or modification of this permit in accordance with ADEM Admin. Code Rules 335-14-8-.04(2), 335-14-8-.04(3), and 335-14-8-.04(4) and could lead to potential enforcement action. The Permittee must inform ADEM of any deviation from or changes in the information provided in the Application that would affect the Permittee's ability to comply with the applicable regulations or permit conditions.

This permit is effective as of September 17, 2019, as modified December xx, 2021 and shall remain in effect until September 16, 2029 unless revoked and reissued, or terminated under ADEM Admin. Code Rules 335-14-8-.04(2) and 335-14-8-.04(4) or continued in accordance with ADEM Admin. Code Rule 335-14-8-.05(2).

Alabama Department of Environmental Management

Date Signed

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Documents Incorporated By Reference:

Part A and Part B Permit Application submitted on December 17, 2018, as modified by subsequent amendments dated April 30, 2019 and May 31, 2019.

Corrective Measures Implementation Work Plan – Upper Opossum Creek, dated May 5, 2005.

Corrective Measures Implementation Work Plan – Coke Plant Area, Former Ensley Works, dated October 4, 2006.

Corrective Measures Implementation Work Plan for Lower Opossum Creek and Lower-Lower Opossum Creek developed and submitted by Beazer East, Inc. on July 10, 2015, as modified by subsequent amendments dated August 2015.

Monitoring Well LF-14 Modification Plan, dated July 10, 2015.

Monitoring Well LF-14 Schematic, dated December 5, 2016.

Corrective Measures Implementation Documentation Report for Lower Opossum Creek and Lower-Lower Opossum Creek developed and submitted by Beazer East, Inc., which was approved in a letter dated August 8, 2018.

Corrective Measures Implementation Plan for Fairfield Works and AOC 3, dated January 10, 2019.

Corrective Measures Implementation Plan for Exum Material Management Area, dated July 27, 2021.

PART I

STANDARD AND GENERAL FACILITY CONDITIONS

I.A. EFFECT OF PERMIT

Issuance of this permit does not authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local law or regulations. Compliance with the terms of this permit does not constitute a defense to any action brought under the AHWMMA, or any other law governing protection of public health or the environment, for any imminent and substantial endangerment to human health, welfare, or the environment.

I.B. SEVERABILITY

The provisions of this permit are severable and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

I.C. DUTIES AND REQUIREMENTS

1. Duty to Comply

   The Permittee shall comply with all conditions of this permit, except to the extent and for the duration such noncompliance is authorized by an emergency permit. Any permit noncompliance, other than noncompliance authorized by an emergency permit, constitutes a violation of the AHWMMA, and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or denial of a permit renewal application.

2. Duty to Reapply

   a. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit.

   b. The Permittee must submit an application for a new permit for both post-closure and Solid Waste Management Unit (SWMU) corrective action at least 180 calendar days before the expiration of this permit. The Permittee must reapply in order to fulfill the 30-year post-closure care period required by ADEM Admin. Code Rule 335-14-5-.07(8)(a)1. The Department may shorten or extend the post-closure care period applicable to the hazardous waste facility in accordance with ADEM Admin. Code Rules 335-14-5-.07(8)(a)2. and 335-14-8-.03(1)(b).

3. Need to Halt or Reduce Activity Not A Defense

   It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

4. Duty to Mitigate

In the event of noncompliance with this permit, the Permittee shall take all reasonable steps to minimize releases to the environment, and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment.

5. Proper Operation and Maintenance

The Permittee shall, at all times, properly operate and maintain all facilities and systems of treatment, monitoring, and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance (O&M) includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this permit.

6. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause as specified in ADEM Admin. Code Rules 335-14-8-.04(2), (3) and (4). The filing of a request for a permit modification, revocation and reissuance, or termination, or the notification of planned changes or anticipated noncompliance on the part of the Permittee does not stay any permit condition.

7. Property Rights

Issuance of this permit does not convey any property rights of any sort, nor any exclusive privilege.

8. Duty to Provide Information

The Permittee shall furnish to the Department, within a reasonable time as determined by the Department, any relevant information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The Permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

9. Inspection and Entry

The Permittee shall allow duly designated officers and employees of the Department or their authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter at reasonable times upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

d. Sample or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the AHWMMA, any substances or parameters at any location. The Permittee shall have the opportunity to split samples during sampling.

10. Monitoring and Records

a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The method used to obtain a representative sample of the waste to be analyzed must be the appropriate method from ADEM Admin. Code Rule 335-14-2-Appendix I or the methods specified in Appendix C of the permit application. Laboratory methods must be those specified in Test Methods for Evaluating Solid Waste: Physical/Chemical Methods SW-846 (latest edition), Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020), Standard Methods for the Examination of Water and Wastewater (latest edition), the methods specified in Appendix C of the permit application, or an alternative method approved by ADEM. [ADEM Admin. Code Rule 335-14-8-.03(1)(j)1.]

b. The Permittee shall maintain at the facility records of all monitoring information including all calibration and maintenance records, all original strip chart recordings for continuous monitoring instrumentation, the certification required by 335-14-5-.05(4)(b)9., records of all data used to prepare documents required by this permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three (3) years from the date of the certification, application, sample, measurement, report or record, or until corrective action is completed, whichever date is later. This period may be extended by the Department at any time and is automatically extended during the course of any unresolved enforcement action regarding this facility. [ADEM Admin. Code Rules 335-14-5-.05(5)(b) and 335-14-8-.03(1)(j)2.]

c. The Permittee shall maintain at the facility records of all groundwater monitoring wells, piezometers and associated groundwater surface elevations throughout the post-closure care period. These records shall include the surveyed location, surveyed elevation, surveyed elevation reference point, total depth, screened interval, construction details, well log, and all other pertinent information for each well and piezometer.

d. Records for monitoring information shall include:

i. The date(s), exact place, and times of sampling or measurements;

ii. The names of individual(s) who performed the sampling or measurements;

iii. The date(s) analyses were performed;

iv. The names of individual(s) who performed the analyses;

v. The analytical techniques or methods used; and,

vi. The results of such analyses.

e. The following documents and information shall be maintained throughout the post-closure care period at the United States Steel Corporation, Fairfield, Alabama facility.

i. Complete copy of this permit and the permit application.

ii. Operating record as required by ADEM Admin. Code Rule 335-14-5-.05(4) and this permit.

iii. Copies of all plans, reports, inspection schedules, inspection logs as required by ADEM Admin. Code Rule 335-14-5 and this permit.

11. Signatory Requirements

All applications, reports or information required by this permit and submitted to the Department shall be signed and certified in accordance with ADEM Admin. Code Rules 335-14-8-.02(2) and 335-14-8-.03(1)(k).

12. Reporting Requirements

a. Planned Changes

The Permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility and any solid waste management units identified under Part IV of this permit.

b. Anticipated Noncompliance

The Permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

c. Transfer of Permits

This permit may be transferred to a new owner or operator only if it is modified or revoked and reissued pursuant to ADEM Admin. Code Rule 335-14-8-.04(1) or 335-14-8-.04(3)(a)1.(vii). Before transferring ownership or operation of the facility during its post-closure period, the Permittee shall notify the new owner or operator, in writing, of the requirements of ADEM Admin. Code Rules 335-14-5 and 335-14-8 and this permit.

d. Monitoring Reports

Monitoring results shall be reported at the intervals specified elsewhere in this permit.

e. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted to the Department no later than 14 calendar days following each schedule date.

f. Twenty-Four Hour Reporting

i. The Permittee shall report to the Department any noncompliance with this permit that may endanger human health or the environment. Any such information shall be reported orally within 24 hours from the time the Permittee becomes aware of the circumstances. This report shall include, but is not limited to, the following:

(I) Information concerning the release of any hazardous waste which may endanger public drinking water supplies; and,

(II) Information concerning the release or discharge of any hazardous waste, or hazardous waste constituents, or of a fire or explosion at the facility, which could threaten the environment or human health outside the facility.

ii. The description of the occurrence and its cause shall include:

(I) Name, address, and telephone number of the owner or operator;

(II) Name, address, telephone number, and EPA Identification Number of the facility;

(III) Date, time, and type of incident;

(IV) Name and quantity of material(s) involved;

(V) The extent of injuries, if any;

(VI) An assessment of actual or potential hazards to the environment and human health outside the facility, where this is applicable; and,

(VII) Estimated quantity and disposition of recovered material that resulted from the accident.

iii. A written submission shall also be provided within 5 calendar days of the time that the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its

cause; the periods of noncompliance (including exact dates and times); whether the noncompliance has been corrected, and if not, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

g. Other Noncompliance

The Permittee shall report to the Department all instances of noncompliance not otherwise required by Permit Conditions I.C.12.d., I.C.12.e., or I.C.12.f. at the time any other reports required by this permit are submitted. The reports shall contain the information required by Permit Condition I.C.12.f.

h. Other Information

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information. In addition, upon request, the Permittee shall furnish to the Department any information related to compliance with this permit.

13. Certification of Construction

The Permittee may not commence treatment, storage or disposal of hazardous waste or contaminated media at any new or modified portion of the facility until the Permittee has submitted to the Department, by certified mail or hand-delivery, a letter (together with the certification by the construction quality assurance officer required by ADEM Admin. Code R. 335-14-5-.02(10)(d) and any other certifications required by this permit or ADEM Admin. Code Rule 335-14) signed by the Permittee and an Alabama-registered professional engineer, stating that the facility has been constructed or modified in compliance with this permit where appropriate; and,

a. The Department has inspected the modified or newly constructed facility and finds it is in compliance with the conditions of this permit; or

b. The Department has either waived the inspection or has not notified the Permittee, within 15 calendar days of the notification from the Permittee, of its intent to inspect. [ADEM Admin. Code Rule 335-14-8-.03(1)(1)2.]

14. The Permittee shall assure that all measures necessary to maintain and/or achieve compliance with all applicable requirements of ADEM Admin. Code Rules 335-14 are taken during the active life of the facility and throughout the post-closure care period, corrective action period, and the term of this permit.

15. In the event that circumstances beyond the Permittee's control arise to prevent achievement of any deadline set forth by this permit, the Permittee may immediately, upon the occurrence thereof, request an extension by sending a written request to the Department explaining the need for the extension. The Department may, after consideration of the circumstances, grant the extension. Requests for extensions may require a permit modification pursuant to ADEM Admin. Code Rule 335-14-8-.04(2) or (3).

I.D. DEFINITIONS

For the purposes of this permit, terms used herein shall have the same meaning as those in ADEM Admin. Code Rules 335-14-1, 335-14-2, 335-14-5, and 335-14-8, unless this permit specifically provides otherwise. Where terms are not defined in the regulations or this permit, a standard dictionary reference or the generally accepted scientific or industrial meaning of the term shall define the meaning associated with such terms.

"Area of concern" (AOC), for the purposes of this permit, includes any area having a probable release of a hazardous waste or hazardous constituent which is not from a solid waste management unit and is determined by the Department to pose a current or potential threat to human health or the environment. Such areas of concern may require investigations and remedial action as required under Section 3005(c)(3) of the Resource Conservation and Recovery Act and ADEM Admin. Code Rule 335-14-8-.03(3)(b)2. in order to ensure adequate protection of human health and the environment.

"Contamination," for the purposes of this permit, refers to the presence of any hazardous constituent in a concentration that exceeds the naturally occurring concentration of that constituent in the immediate vicinity of the facility (*i.e.*, areas not affected by the facility).

"Extent of contamination," for the purposes of this permit, is defined as the horizontal and vertical areas in which the concentrations of hazardous constituents in the environmental media being investigated are above detection limits or background concentrations indicative of the region, whichever is appropriate as determined by the Department.

"Hazardous constituents," for the purposes of this permit, are those substances listed in ADEM Admin. Code Rule 335-14-2-Appendix VIII and/or ADEM Admin. Code Rule 335-14-5-Appendix IX and include hazardous constituents released from solid waste, hazardous waste, and hazardous waste constituents that are reaction by-products.

“Land Use Controls,” for the purposes of this permit, is as defined by ADEM Admin. Code Rule 335-5-1-.03.

“Method detection limit” (MDL), for the purposes of this permit, means the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.

“Mixed waste,” for the purposes of this permit, means a solid waste that is a mixture of hazardous waste (as defined in ADEM Admin. Code Rule 335-14-2-.01(3)) and radioactive waste (as defined in 10 CFR 61.2). The radioactive component of mixed waste is subject to regulation by the Atomic Energy Act (AEA)/Nuclear Regulatory Commission (NRC). The non-radioactive chemically hazardous component of mixed waste is subject to regulation by the AHWMMA and ADEM Admin. Code Rule 335-14.

“Operating day,” for the purposes of this permit, means any day on which hazardous waste is treated, stored, or disposed of in a unit. For example, each day that a hazardous waste storage unit contains hazardous waste is an operating day; as is each day that a disposal unit contains or receives hazardous waste, or each day that hazardous waste is treated in a treatment unit.

"Release," for the purposes of this permit, includes any spilling, leaking, pouring, emitting, emptying, discharging, injecting, escaping, leaching, pumping, or disposing into the environment of any hazardous waste or hazardous constituent.

"Solid waste management unit" (SWMU), for the purposes of this permit, includes any unit that has been used for the treatment, storage or disposal of solid waste at any time, irrespective of whether the unit is or ever was intended for the management of solid waste. RCRA-regulated hazardous waste management units are also solid waste management units. SWMUs include areas that have been contaminated by routine and systematic releases of hazardous waste or hazardous constituents, excluding one-time accidental spills that are immediately remediated and cannot be linked to solid waste management activities (*e.g.*, product or process spills).

"Storm event," for the purposes of this permit, is defined as a 1-year, 24-hour storm event or rainfall that measures 1-inch or greater in 1 hour or less. Rainfall measurements may be taken at the site, or the closest official weather monitoring station may be used.

I.E. EXPIRATION AND CONTINUATION OF PERMIT

This permit and all conditions herein will remain in effect beyond this permit's expiration date if the Permittee has submitted a new application as required by Permit Condition I.C.2. and, through no fault of the Permittee, the Department has not issued a new permit.

I.F. WASTE MINIMIZATION

1. Certification Requirements

   Pursuant to ADEM Admin. Code Rule 335-14-5-.05(4)(b)9. the Permittee must certify, no less often than annually, that:

   a. The Permittee has a program in place to reduce the volume and toxicity of hazardous waste to the degree determined by the Permittee to be economically practicable; and,

   b. The proposed method of treatment, storage or disposal is the most practicable method available to the Permittee and that it minimizes the present and future threat to human health and the environment.

2. Recording Requirements

   The Permittee shall maintain copies of this certification in the facility operating record as required by ADEM Admin. Code Rule 335-14-5-.05(4).

I.G. COST ESTIMATES

1. The Permittee shall maintain detailed written cost estimates, in current dollars, at the location specified in Permit Condition I.C.10.e. and on file with ADEM in accordance with ADEM Admin. Code Rules 335-14-5-.08(3), (5), and (10).

2. All cost estimates must be updated annually as required by ADEM Admin. Code Rule 335-14-5-.08(3)(b), (5)(b), and (10)(b).

3. The cost estimate shall be maintained and submitted in the form designated by the Department.

4. The Permittee must update the cost estimate no later than 30 calendar days after the Department has approved a modification to the Closure Plan, Post-Closure Plan, or Corrective Action Plan, or any other plan required or referenced by this permit, if the change in the plan results in an increase in the amount of the cost estimate.

I.H. FINANCIAL ASSURANCE

1. The Permittee shall demonstrate continuous compliance with ADEM Admin. Code Rule 335-14-5-.08 by providing documentation of financial assurance in at least the amount that equals or exceeds the cost estimate. Changes in financial assurance mechanisms must be approved by the Department.

2. The Permittee shall submit itemized statements for all capital expenditures and a complete, revised post-closure and corrective action cost estimate to the Department when requesting approval for a reduction in the financial assurance mechanism.

I.I. PERMIT MODIFICATIONS

The Permittee shall request a permit modification whenever changes in operating plans or facility design affect any plan (*e.g.*, closure, groundwater monitoring, post-closure, or corrective action) required or referenced by this permit. The Permittee must submit a written request for a permit modification pursuant to the requirements of ADEM Admin. Code Rule 335-14-8-.04(2) at least 60 calendar days prior to the proposed change in facility design or operation.

I.J. REPORTS, NOTIFICATIONS, AND SUBMISSIONS TO THE DEPARTMENT

One hard copy and one electronic (an optical character recognition or text-searchable) copy of all reports, notifications, or other submissions that are required by this permit should be sent via certified mail or given to:

Chief, Land Division
Alabama Department of Environmental Management
P.O. Box 301463 (Zip 36130-1463)
1400 Coliseum Boulevard (Zip 36110-2059)
Montgomery, Alabama

PART II

POST-CLOSURE CARE

II.A. POST-CLOSURE CARE PERIOD

The post-closure care period shall extend for a period of thirty (30) years after the date of issuance of a post-closure permit unless shortened or extended pursuant to ADEM Admin. Code Rule 335-14-5-.07(8). The post-closure care period shall automatically extend through the end of the compliance period specified in Part III of this permit.

II.B. POST-CLOSURE PROCEDURES AND USE OF PROPERTY

1. Post-Closure Activities

   The Permittee shall conduct post-closure care activities, in accordance with Section 1.6 of the permit application and as required by ADEM Admin. Code Rules 335-14-5-.07 and 335-14-5-.14(11)(d), for each hazardous waste management unit listed in Table II.1. Post-closure care shall commence upon the effective date of this permit and shall continue throughout the post-closure care period.

2. Security

   The Permittee shall comply with the security provisions of ADEM Admin. Code Rules 335-14-5-.02(5) and as described in Section 1.3 of the permit application.

3. Disturbance of Closed Unit(s)

   The Permittee shall not allow the disturbance of the integrity of the final cover, liners, any components of the containment system, or the function of the facility's monitoring systems during the post-closure care period for any unit identified in Table II.1.

4. The Permittee shall:

   a. Maintain the integrity and effectiveness of the final cover, including making repairs to the cap, as necessary, to correct the effects of settling, subsidence, erosion, or other events;

   b. Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of ADEM Admin. Code Rule 335-14-5-.06 and Part III of this permit;

   c. Prevent run-on and run-off from eroding or otherwise damaging the final cover; and,

   d. Protect and maintain surveyed benchmarks used in complying with the surveying and recordkeeping requirements of ADEM Admin. Code Rule 335-14-5-.14(10).

II.C. INSPECTIONS

1. The Permittee shall inspect the components, structures, and equipment at the site in accordance with the inspection schedule as described in Section 1.4 of the permit application, the post-closure care plan as described in Section 1.6 of the permit application, and as required by ADEM Admin. Code Rule 335-14-5-.07.

2. Monitoring and Inspection

   The Permittee shall inspect the closed hazardous waste management unit(s) listed in Table II.1 at least weekly and after storms to detect any evidence of deterioration or improper operation as described in Section 1.4, 1.6, 3.0, and Appendix C of the permit application and as required under ADEM Admin. Code Rules 335-14-5-.07 and 335-14-5-.14. The inspections shall specifically include evaluation of the following items:

   a. Integrity of the final cover (erosion, ponding, subsidence, cracking, *etc.*);

   b. Growth and stabilization of vegetative cover;

   c. Run-on and run-off control system;

   d. Groundwater monitoring wells; and,

   e. Survey benchmarks.

TABLE II.1

POST-CLOSURE CARE UNITS

UNIT NAME	UNIT DESCRIPTION	CLOSED-IN-PLACE CAPACITY (QUANTITY)	DESCRIPTION OF UNIT*	LOCATION OF UNIT*
SWMU-11 (Subunit 5 of Unit D-6)	Surface impoundment closed as a Landfill	143 acre-feet	Section 1.0	Figure 2A

* Location in permit application containing description (text) and location (figure) of unit.

PART III

GROUNDWATER MONITORING AND CORRECTIVE ACTION

III.A. REQUIRED PROGRAM(S)

1. Groundwater monitoring shall consist of the General Groundwater Monitoring Program of Permit Condition III.B. and the Corrective Action Monitoring contained in Permit Condition III.E.

2. The Permittee shall commence groundwater monitoring as required by this permit not later than 120 calendar days after the effective date of this permit.

III.B. GENERAL GROUNDWATER MONITORING PROGRAM

1. Well Location, Installation and Construction

   The Permittee shall install and/or maintain a groundwater monitoring system to comply with the requirements of ADEM Admin. Code Rules 335-14-5-.06(8), 335-14-5-.06(9), 335-14-5-.06(10), and 335-14-5-.06(11) as applicable and as specified below:

   a. The Permittee shall maintain all groundwater monitoring wells at the facility as identified in Table III.1. of this permit, at the locations specified on Figure 2A of the permit application, Figure 4-3 of the AOC-3 CMI Plan, Figure 1-3 of the SWMU-23 (Exum) CMI Plan, and any other groundwater monitoring wells specified by Permit Condition III.B.1.d.

      i. All groundwater monitoring wells shall be maintained in accordance with the plans and specifications presented in Section 3.0 of the permit application, Section 4.9 of the AOC-3 CMI Plan, Section 4.8 of the SWMU-23 (Exum) CMI Plan and in accordance with ADEM Admin. Code Rule 335-14-5-.06.

      ii. A groundwater monitoring well shall not be removed from any monitoring program specified in this permit without an approved permit modification pursuant to Permit Condition I.I.

      iii. If a groundwater monitoring well is damaged, the Permittee shall immediately notify the Department in writing, which includes a description of the well repair activities to be conducted. The well repair procedures must be approved by the Department prior to implementation. Within 30 calendar days after the well is repaired, the Permittee shall submit a written notification to the Department that the well repair activities were conducted in accordance with the approved procedures.

      iv. If a groundwater monitoring well is deleted from the monitoring program(s) required by this permit in accordance with Permit Conditions III.B.1.a.ii. and I.I., it shall be abandoned within 90 calendar days after deletion using procedures to be approved by the Department. Within 30

calendar days after the well is abandoned, the Permittee shall submit a written notification to the Department that the well abandonment activities were conducted in accordance with the approved procedures.

b. Groundwater monitoring wells LF-11, LF-12, and LF-21 shall define the point of compliance for SWMU-11 (Unit D-6).

c. The Permittee shall maintain groundwater monitoring well(s) LF-6, LF-25, and LF-26 as the background monitoring well(s) for the entire facility as specified in Section 3.0 of the permit application.

d. The Permittee shall install and maintain additional groundwater monitoring wells as necessary to assess changes in the rate and extent of any plume of contamination or as otherwise deemed necessary to maintain compliance with ADEM Admin. Code Rules 335-14-5-.06(6), 335-14-5-.06(8), 335-14-5-.06(9), 335-14-5-.06(10), and 335-14-5-.06(11), as applicable. A plan in the form of a permit modification request specifying the design, location and installation of any additional monitoring wells should be submitted to the Department at least 90 calendar days prior to installation which, at a minimum, shall include:

i. Well construction techniques including casing depths and proposed total depth of well(s);

ii. Well development method(s);

iii. A complete description of well construction materials;

iv. A schedule of implementation for construction; and,

v. Provisions for determining the lithologic characteristics, hydraulic conductivity, grain size distribution, and porosity for the applicable aquifer unit(s) at the location of the new well(s).

e. Reserved

f. Reserved

2. General Groundwater Monitoring Requirements

a. The Permittee shall determine the groundwater surface elevation from all monitoring wells listed in Table III.1. of this permit at least semi-annually and each time a sampling event is conducted. The results of these determinations should be submitted in accordance with Permit Condition III.B.6. Elevation data should be recorded and reported as mean sea level (MSL) and referenced to an appropriate national geodetic vertical datum (NGVD) benchmark.

b. The Permittee shall determine the groundwater flow rate and direction in the underlying aquifer(s) at least annually and submit the results in accordance with Permit Condition III.B.6.

c. The Permittee shall determine background concentrations of hazardous constituents and other chemical parameters required to be monitored by this permit in accordance with Section 3.0 of the permit application and ADEM Admin. Code Rule 335-14-5-.06(8)(g).

3. Groundwater Protection Standard

a. The groundwater protection standard, as required under ADEM Admin. Code Rule 335-14-5-.06(3), shall consist of Table III.3 of this permit which lists the hazardous constituents and their respective concentration limits.

b. The groundwater protection standard applies to all hazardous waste or hazardous constituent releases as deemed appropriate by the Department to protect human health and the environment.

4. Compliance Period

a. The compliance period, during which the groundwater protection standard specified in Permit Condition III.B.3. applies, shall begin at the time of the first sampling event of the compliance monitoring program (Permit Condition III.D.), or the corrective action monitoring program (Permit Condition III.E.), whichever is earlier.

b. The compliance period shall continue (after beginning pursuant to Permit Condition III.B.4.a.) until the groundwater protection standard as defined by Permit Condition III.B.3.a. has not been exceeded for a period of three consecutive years.

c. If the Permittee is engaged in a corrective action program pursuant to Permit Condition III.E., then the compliance period shall continue as required by ADEM Admin. Code Rule 335-14-5-.06(7)(c) until the groundwater protection standard has not been exceeded for a period of three consecutive years after corrective action has been terminated and this permit has been modified, in accordance with Permit Condition III.I., to implement a compliance monitoring program pursuant to Permit Condition III.D. or a detection monitoring program pursuant to Permit Condition III.C., as required by ADEM Admin. Code Rule 335-14-5-.06(11)(f).

5. Sampling and Analysis Procedures

The Permittee shall use the following techniques and procedures when obtaining and analyzing samples from the groundwater monitoring wells described in Permit Condition III.B.1. to provide a reliable indication of the quality of the groundwater as required under ADEM Admin. Code Rules 335-14-5-.06(8)(d), (e), and (g):

a. Samples shall be collected, preserved, and shipped (when shipped off-site for analysis) in accordance with the procedures specified in Section 3.0 and Appendix C of the permit application.

b. Samples shall be analyzed according to the procedures specified in Section 3.0 and Appendix C of the permit application, the most recent edition of SW-846 or

other appropriate methods approved by the Department. Analytical method detection limits shall be less than or equal to the concentration limits specified in Table III.2 or III.3, unless otherwise approved in writing by the Department.

c. Samples shall be tracked and controlled using the chain-of-custody procedures specified in Section 3.0 and Appendix C of the permit application.

d. Statistical analyses used to evaluate the groundwater monitoring data shall be as described in Section 3.0 and Appendix C of the permit application and ADEM Admin. Code Rule 335-14-5-.06(8)(h).

e. All samples taken in accordance with this permit shall not be filtered prior to analysis.

6. Recordkeeping and Reporting

a. The Permittee shall keep and maintain all monitoring, testing, and analytical data obtained in accordance with Permit Conditions III.B., III.C., III.D., and III.E. as required by Permit Condition I.C.10.

b. The Permittee shall submit to the Department a written report to include all analytical sampling data, established background values, statistical evaluations, groundwater elevations, associated potentiometric maps, and the annual groundwater flow rate and direction determinations. The analytical method and the method detection limit (MDL) for each constituent must be integrated into all reports of analysis. The report shall be submitted within 60 calendar days after the first sampling event and on an annual basis thereafter. Copies of this report shall be kept at the facility in accordance with Permit Conditions I.C.10.c. and I.C.10.e.

c. The Permittee shall submit progress reports to the Department describing implementation of groundwater monitoring and/or corrective action activities at the site as required by Part III of this permit on a quarterly basis. The first progress report shall be submitted to the Department within 90 calendar days after the effective date of this permit. The progress reports shall continue until such time as the required monitoring and/or corrective action systems and activities required by this permit are fully constructed and operational. In the event that additional monitoring and/or corrective action requirements are imposed through a permit modification, the quarterly reporting requirement shall resume, commencing upon the effective date of the permit modification and continuing until the required monitoring and/or corrective action systems and activities are again fully constructed and operational.

III.C. DETECTION MONITORING PROGRAM (Reserved)

III.D. COMPLIANCE MONITORING PROGRAM (Reserved)

III.E. CORRECTIVE ACTION MONITORING PROGRAM

The requirements of this Condition are applicable to SWMU-11 (Unit D-6) and AOC-3. Except as specified otherwise in this permit, the Corrective Action Monitoring Program shall be implemented in accordance with Section 3.0 and Appendix C of the permit application, the AOC-3 CMI Plan, and ADEM Admin. Code Rule 335-14-5-.06(11).

1. Monitoring Systems

   In addition to the point of compliance and background monitoring well systems identified in Permit Conditions III.B.1.b. and III.B.1.c., the Permittee shall:

   a. Maintain groundwater monitoring wells LF-7, LF-8, LF-14, LF-15, LF-17C, LF-20, LF-22, LF-23, LF-24, and spring locations Site 6 (SP) and Site 6d (SPDS) as boundary wells for SWMU-11 (Unit D-6) as specified in Table III.1. of this permit and as shown on Figure 2A of the permit application.

   b. Maintain groundwater monitoring wells LF-17A and LF-17B as effectiveness wells for SWMU-11 (Unit D-6) as specified in Table III.1. of this permit and as shown on Figure 2A of the permit application.

   c. Maintain wells LF-11, LF-12, and LF-21 as point of compliance wells for SWMU-11 (Unit D-6) as specified in Table III.1. of this permit and as shown on Figure 2A of the permit application.

   d. Maintain well MWO-21 as an upgradient well and wells MWO-2, MWO-4, and MWO-14 as downgradient/point of compliance wells for AOC-3 as specified in Table III.1 of this permit and as shown in Figure 4-3 of the AOC-3 CMI Plan.

   f. Maintain well MW-10 as an upgradient well and wells MW-6, MW-15, and MWO-17 as downgradient/point of compliance wells for SWMU-23 as specified in Table III.1 of this permit and as shown in Figure 1-3 of the Exum (SWMU-23) CMI Plan.

2. Corrective Action Program

   a. The Permittee shall conduct a Corrective Action Program, as described in Section 3.0 and Appendix C of the permit application, Section 4.9 of the AOC-3 CMI Plan, and Section 4.8 of SWMU-23 (Exum) CMI Plan to remove or treat in place all hazardous constituents that exceed their respective groundwater protection standards as described in Table III.3. of this permit at the point of compliance, between the point of compliance and the down-gradient facility property boundary, and beyond the facility boundary in accordance with ADEM Admin. Code Rule 335-14-5-.06(11)(e)2.

   b. Pursuant to ADEM Admin. Code Rules 335-14-5-.06(11)(c) and 335-14-5-.06(11)(e)3., the Permittee shall continue to implement the corrective action program as described in Section 3.0 and Appendix C of the permit application, Section 4.9 of the AOC-3 CMI Plan, and Section 4.8 of the SWMU-23 (Exum) CMI Plan within 120 calendar days after the effective date of this permit.

c. The Permittee shall handle or treat groundwater in accordance with Section 3.0 and Appendix C of the permit application, the AOC-3 CMI Plan, the SWMU-23 (Exum) CMI Plan, and with the applicable requirements of NPDES permit number(s) AL0003646 and AIR permit number(s) 407037105 and 40737003, as issued by the Department.

3. Monitoring Requirements

In addition to the general groundwater monitoring requirements specified in Permit Condition III.B.2., the Permittee shall:

a. Sample all background, point of compliance, and effectiveness monitoring wells shown in Table III.1. of this permit and analyze for the constituents listed in Table III.2. of this permit on a semi-annual basis for SWMU-11 (Unit D-6) and an annual basis for AOC-3 and SWMU-23 (Exum) beginning within 120 calendar days of the effective date of this permit and continuing through the end of the compliance period.

b. Sample all background, point of compliance, effectiveness, and boundary monitoring wells shown in Table III.1. of this permit and analyze for the constituents listed in Table III.3. of this permit on an annual basis beginning within 120 calendar days of the effective date of this permit and continuing through the end of the compliance period.

c. Sample all background, point of compliance, effectiveness, and boundary monitoring wells shown in Table III.1. of this permit and analyze for temperature (degrees F or C), specific conductance (Mhos/cm), and pH (standard units) each time the well is sampled. The data obtained should be submitted as raw data in the reports required by Permit Condition III.B.6.

d. When evaluating the monitoring results to determine the effectiveness of the corrective measures, in accordance with Permit Condition III.E.4., the Permittee shall:

i. Determine if the corrective action system effectively addresses the entire plume of contamination;

ii. Determine if the concentration of the hazardous constituents are decreasing (pH increasing or decreasing toward neutrality, as applicable) in the effectiveness wells specified in Permit Condition III.A.1.;

iii. Determine if hazardous waste or hazardous constituents are being released into the environment; and,

iv. Determine if hazardous constituents have been detected in the boundary wells specified in Permit Condition III.A.1.

4. Reporting and Response Requirements

In addition to the recordkeeping and reporting requirements specified in Permit Condition III.B.6.:

a. The Permittee shall report the effectiveness of the corrective action program annually, as required under ADEM Admin. Code Rule 335-14-5-.06(11)(g). These reports shall be submitted to the Department within 60 calendar days of each annual anniversary of this permit after corrective action is initiated and continue until corrective action is completed. The Permittee must provide data from groundwater monitoring along with an analysis of that data and any conclusions regarding the effectiveness of the program in accordance with Permit Condition III.E.3.d. If the analysis of the data warrants any change to the corrective action program, the Permittee must include these revisions in the annual report, which will be followed-up within 90 calendar days with an application for permit modification in accordance with Permit Condition I.I.

b. If corrective action is terminated under Permit Condition III.B.4.c., the Permittee must sample all background, point of compliance, effectiveness and boundary sampling locations for the compounds listed in ADEM Admin. Code Rule 335-14-5-Appendix IX. Based upon the sampling results, the Permittee may petition the Department, in accordance with Permit Condition I.I., for a permit modification to implement either a detection monitoring program or a compliance monitoring program.

TABLE III.1

MONITORING WELL DESIGNATIONS

WELL NUMBER	WELL TYPE*	WELL LATITUDE	WELL LONGITUDE	UNIT(S) MONITORED	WELL DEPTH (ft-btoc)	GROUND ELEVATION (ft-amsl)	TOP OF RISER ELEVATION (ft-amsl)	SCREENED INTERVAL (ft-amsl)	MONITORED ZONE
LF-9	PGM	33° 29' 01" N	86° 56' 59" W	SWMU-11 (UNIT D-6)	135.14	664.41	666.36	550.96-531.21	Lower
LF-13A	PGM	33° 29' 09" N	86° 57' 05" W	SWMU-11 (UNIT D-6)	98.40	671.82	672.50	589.82-574.82	Upper
LF-16	PGM	33° 28' 52" N	86° 56' 53" W	SWMU-11 (UNIT D-6)	152.05	602.68	605.72	473.68-453.68	Lower
PZ-2	PGM	33° 29' 13" N	86° 56' 50" W	SWMU-11 (UNIT D-6)	171.38	690.75	690.94	536.75-526.75	Upper
LF-6	BKG	33° 29' 21" N	86° 57' 04" W	SWMU-11 (UNIT D-6)	49.95	706.70	708.26	674.60-654.60	Upper
LF-25	BKG	33° 28' 53" N	86° 56' 56" W	SWMU-11 (UNIT D-6)	135.63	616.48	616.69	490.48-480.48	Lower
LF-26	BKG	33° 29' 20" N	86° 57' 04" W	SWMU-11 (UNIT D-6)	175.17	701.27	702.28	546.52-526.52	Upper
LF-11	POC	33° 29' 18" N	86° 56' 56" W	SWMU-11 (UNIT D-6)	153.01	694.21	695.84	563.21-543.21	Upper
LF-12	POC	33° 29' 15" N	86° 57' 05" W	SWMU-11 (UNIT D-6)	152.85	705.34	706.27	574.09-554.09	Upper
LF-21	POC	33° 29' 11" N	86° 56' 59" W	SWMU-11 (UNIT D-6)	105.78	691.73	692.44	631.73-591.73	Upper
LF-17A	EFF	33° 29' 20" N	86° 56' 55" W	SWMU-11 (UNIT D-6)	44.12	656.17	657.58	633.37-613.57	Upper
LF-17B	EFF	33° 29' 20" N	86° 56' 55" W	SWMU-11 (UNIT D-6)	150.88	655.92	657.54	525.12-505.37	Upper
LF-7	BDY	33° 29' 05" N	86° 56' 56" W	SWMU-11 (UNIT D-6)	130.71	647.28	648.76	537.78-518.03	Lower
LF-8	BDY	33° 29' 05" N	86° 57' 02" W	SWMU-11 (UNIT D-6)	112.34	634.11	634.44	542.36-522.61	Lower
LF-14	BDY	33° 29' 09" N	86° 56' 48" W	SWMU-11 (UNIT D-6)	65.40	646.48	648.49	602.00-582.00	Upper
LF-15	BDY	33° 29' 05" N	86° 57' 06" W	SWMU-11 (UNIT D-6)	151.86	634.35	635.57	505.60-485.60	Lower
LF-17C	BDY	33° 29' 20" N	86° 56' 55" W	SWMU-11 (UNIT D-6)	305.37	656.19	657.79	375.20-356.55	Lower
LF-20	BDY	33° 29' 04" N	86° 57' 08" W	SWMU-11 (UNIT D-6)	148.91	641.23	642.86	513.48-493.78	Lower
LF-22	BDY	33° 29' 21" N	86° 57' 04" W	SWMU-11 (UNIT D-6)	500.36	706.42	707.47	316.42-216.42	Lower
LF-23	BDY	33° 29' 18" N	86° 56' 47" W	SWMU-11 (UNIT D-6)	105.35	691.62	692.63	631.62-591.62	Upper
LF-24	BDY	33° 29' 26" N	86° 56' 44" W	SWMU-11 (UNIT D-6)	51.17	649.32	651.36	609.32-599.32	Upper

WELL NUMBER	WELL TYPE*	WELL LATITUDE	WELL LONGITUDE	UNIT(S) MONITORED	WELL DEPTH (ft-btoc)	GROUND ELEVATION (ft-amsl)	TOP OF RISER ELEVATION (ft-amsl)	SCREENED INTERVAL (ft-amsl)	MONITORED ZONE
Site 6 Spring (SP)	BDY	33° 29' 24.2" N	86° 56' 44.6" W	---	---	629.67	---	---	---
Site 6D** (SPDS)	BDY	33° 29' 23.9" N	86° 56' 44.0" W	---	---	623.41	---	---	---
MWO-2	DNG/POC	33°28'53.01" N	86°55'36.32" W	AOC-3	29.88	NA	542.21	512.33-502.33	Opossum Valley
MWO-4	DNG/POC	33° 29' 0.34" N	86° 55' 15.6" W	AOC-3	43.42	NA	546.27	502.85-492.85	Opossum Valley
MWO-14	DNG/POC	33°28'56.99" N	86°55'40.32" W	AOC-3	33.00	NA	553.56	520.56-510.56	Opossum Valley
MWO-21	UPG	33°29'36.68" N	86°55'44.77" W	AOC-3	28.00	NA	584.86	556.86-547.36	Opossum Valley
MW-10	UPG	33°30'29.36" N	86°56'37.10" W	SWMU-23	65.00	NA	603.46	553.46-538.46	Pottsville
MW-6	DNG/POC	33°30'32.06" N	86°56'51.77" W	SWMU-23	35	NA	564.35	545.35-535.35	Pottsville
MW-15	DNG/POC	33°30'24.29" N	86°56'40.32" W	SWMU-23	106.3	NA	607.80	511.80-501.80	Pottsville
MW-17	DNG/POC	33°30'35.66" N	86°56'54.94" W	SWMU-23	36	NA	563.10	540.80-530.60	Pottsville

* Well Type:
PGM - Piezometers and/or General Monitoring Wells
BKG - Background Wells W
POC - Point of Compliance Wells
EFF - Effectiveness Monitoring Wells
BDY - Boundary Monitoring Wells
DNG – Downgradient Monitoring Wells
UPG – Upgradient Monitoring Wells
NA – Data Not Available

** - Site 6D downstream of Site 6
ft-amsl – feet below mean sea level
ft-btoc – feet below top of casing

TABLE III.2

GROUNDWATER QUALITY MONITORING CONSTITUENTS*

HAZARDOUS CONSTITUENT
Arsenic
Barium
Benzene
Bis-(2-ethylhexyl)phthalate
Cadmium
Chloride
Chloroform
Chromium
Cyanide
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
Di-n-octylphthalate
Iron
Isophorone
Lead
Magnesium
Manganese
Mercury
Methylene Chloride
Naphthlene
Phenols
Sodium
Sulfate
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trans-1,2-Dichloroethene
Trichloroethylene
Toluene
Vinyl Chloride

* The constituents listed herein are the subset of the Groundwater Protection Standard listed in Table III.3 for which monitoring is required.

TABLE III.3

GROUNDWATER PROTECTION STANDARD

HAZARDOUS CONSTITUENT	UNIT*	CONCENTRATION LIMIT (mg/L)
Arsenic	SWMUs-11, 23, AOC-3	1.00E-02(2)
Barium	SWMUs-11, 23, AOC-3	2.00E+00(2)
Benzene	SWMUs-11, 23, AOC-3	5.00E-03(2)
Bis-(2-ethylhexyl)phthalate	SWMUs-11, 23, AOC-3	6.00E-03(2)
Cadmium	SWMUs-11, 23, AOC-3	5.00E-03(2)
Chloride	SWMUs-11, 23, AOC-3	2.50E+02(4)
Chloroform	SWMUs-11, 23, AOC-3	8.00E-02(2)
Chromium	SWMUs-11, 23, AOC-3	1.00E-01(2)
Cyanide	SWMUs-11, 23, AOC-3	2.00E-01(2)
1,1-Dichloroethane	SWMUs-11, 23, AOC-3	2.80E-03(3)
1,2-Dichloroethane	SWMUs-11, 23, AOC-3	5.00E-03(2)
1,1-Dichloroethene	SWMUs-11, 23, AOC-3	7.00E-03(2)
Di-n-octylphthalate	SWMUs-11, 23, AOC-3	2.00E-02(3)
Iron	SWMUs-11, 23, AOC-3	1.40E+00(3)
Isophorone	SWMUs-11, 23, AOC-3	7.80E-02(3)
Lead	SWMUs-11, 23, AOC-3	1.50E-02(2)
Magnesium	SWMUs-11, 23, AOC-3	BKG(1)
Manganese	SWMUs-11, 23, AOC-3	4.30E-02(3)
Mercury	SWMUs-11, 23, AOC-3	2.00E-03(2)
Methylene Chloride	SWMUs-11, 23, AOC-3	5.00E-03(2)
Naphthalene	SWMUs-11, 23, AOC-3	1.70E-04(3)
Phenols	SWMUs-11, 23, AOC-3	5.80E-01(3)
Sodium	SWMUs-11, 23, AOC-3	BKG(1)
Sulfate	SWMUs-11, 23, AOC-3	2.50E+02(4)
1,1,1-Trichloroethane	SWMUs-11, 23, AOC-3	2.00E-01(2)
1,1,2-Trichloroethane	SWMUs-11, 23, AOC-3	5.00E-03(2)
Trans-1,2-Dichloroethene	SWMUs-11, 23, AOC-3	1.00E-01(2)
Trichloroethylene	SWMUs-11, 23, AOC-3	5.00E-03(2)
Toluene	SWMUs-11, 23, AOC-3	1.00E+00(2)
Vinyl Chloride	SWMUs-11, 23, AOC-3	2.00E-03(2)

* Identifies the unit(s) at which the given constituent must be monitored.
(1) BKG – compared to background levels
(2) United States Environmental Protection Agency Maximum Contaminant Level (May 2019)
(3) United States Environmental Protection Agency Regional Screening Levels – Tapwater (May 2019)
(4) Secondary Drinking Water Regulation - ADEM Admin Code r. 335-7-3-.02

PART IV

SOLID WASTE MANAGEMENT UNIT IDENTIFICATION AND EVALUATION

IV.A. APPLICABILITY

The Conditions of this Part apply to:

1. The solid waste management units (SWMUs) and areas of concern (AOCs) identified in Table IV.1, which require investigation and/or remediation;

2. The SWMUs identified in Table IV.2, which require no further investigation under this permit at this time;

3. Any additional SWMUs or AOCs discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means; and,

4. Contamination beyond the facility boundary, if applicable. The Permittee shall implement corrective actions beyond the facility boundary where necessary to protect human health and the environment, unless the Permittee demonstrates to the satisfaction of the Department that, despite the Permittee's best efforts, as determined by the Department, the Permittee was unable to obtain the necessary permission to undertake such actions. The Permittee is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. Assurances of financial responsibility for completion of such off-site corrective action will be required.

IV.B. NOTIFICATION AND ASSESSMENT REQUIREMENTS FOR NEWLY IDENTIFIED SWMUs AND AOCs

1. The Permittee shall notify the Department in writing, within 15 calendar days of discovery, of any additional AOC(s) as described under Permit Condition IV.A.3. The notification shall include, at a minimum, the location of the AOC(s) and all available information pertaining to the nature of the release (*e.g.*, media affected, hazardous constituents released, magnitude of release, *etc.*). If the Department determines that further investigation of an AOC is required, the permit will be modified in accordance with ADEM Admin. Code Rule 335-14-8-.04(2).

2. The Permittee shall notify the Department in writing, within 15 calendar days of discovery, of any additional SWMUs as described under Permit Condition IV.A.3.

3. The Permittee shall prepare and submit to the Department, within 90 calendar days of notification, a SWMU Assessment Report (SAR) for each SWMU identified under Permit Condition IV.B.2. At a minimum, the SAR shall provide the following information:

a. Location of unit(s) on a topographic map of appropriate scale such as required under ADEM Admin. Code Rule 335-14-8-.02(5)(b)19.

b. Designation of type and function of unit(s).

c. General dimensions, capacities and structural description of unit(s) (supply any available plans/drawings).

d. Dates that the unit(s) was operated.

e. Specification of all wastes that have been managed at/in the unit(s) to the extent available. Include any available data on hazardous constituents in the wastes.

f. All available information pertaining to any release of hazardous waste or hazardous constituents from such unit(s) (to include groundwater data, soil analyses, air, and/or surface water data).

4. Based upon the results of the SAR, the Department shall determine the need for further investigations at the SWMUs covered in the SAR. If the Department determines that such investigations are needed, the Permittee shall initiate an investigation as outlined in Permit Condition IV.D.1 immediately upon receiving notification of the Department's determination.

IV.C. NOTIFICATION REQUIREMENTS FOR NEWLY DISCOVERED RELEASES AT PREVIOUSLY IDENTIFIED SWMUs or AOCs

1. The Permittee shall notify the Department in writing of any newly discovered release(s) of hazardous waste or hazardous constituents discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means, within 15 calendar days of discovery. Such newly discovered releases may be from SWMUs or AOCs identified in Permit Condition IV.A.2 or SWMUs or AOCs identified in Permit Condition IV.A.3 for which further investigation was not required.

2. If the Department determines that further investigation of the SWMUs or AOCs is needed, the Permittee shall initiate an investigation as outlined in Permit Condition IV.D. immediately upon receiving notification of the Department's determination.

IV.D. RCRA FACILITY INVESTIGATION (RFI)

1. The Permittee must perform a RCRA Facility Investigation (RFI) for any SWMU and AOC identified by the Department in accordance with Permit Conditions IV.A.1, IV.B.4, and IV.C.2.

2. The RFI must completely identify the concentration of hazardous constituents released from each SWMU and AOC and fully delineate the area where such hazardous constituents have come to be located.

3. The RFI must fully characterize the nature and extent of contamination released from each SWMU or AOC under investigation.

4. The RFI must be performed in a manner consistent with the most recent edition of the Alabama Environmental Investigation and Remediation Guidance (AEIRG).

5. Except as provided by Permit Condition IV.D.6., the RFI must be completed within 180 calendar days from the effective date of this permit or, for SWMUs or AOCs identified pursuant to Permit Condition IV.B. and C., within 180 calendar days from the receipt of notification from the Department that an RFI is required. If, prior to the effective date of this permit, the Department has approved a work plan that includes a schedule for completing the RFI, the RFI shall be completed in accordance with the approved schedule.

6. RFI Schedule of Compliance

    a. For RFIs expected to require greater than 180 calendar days to complete, the Permittee may submit a schedule of compliance subject to Departmental approval and/or modification.

    b. Submittal of an RFI Schedule of Compliance does not delay or otherwise postpone the Permittee's obligation to initiate the RFI.

    c. The Schedule of Compliance must include:

        i. A detailed narrative discussion, which explains why the RFI cannot be completed within 180 days; and,

        ii. A detailed and chronological listing of milestones with estimated durations that provides sufficient information to track the progress of the investigation.

    d. The RFI Schedule of Compliance shall be reviewed by the Department in accordance with Permit Condition IV.G.

    e. The Permittee shall complete the RFI in accordance with the approved RFI Schedule of Compliance.

7. RFI Progress Reports

    a. For an RFI being conducted in accordance with the approved RFI Schedule of Compliance, the Permittee must submit progress reports on a monthly basis.

    b. The RFI Progress Reports must include:

        i. A description of the RFI activities completed during the reporting period;

        ii. Summaries of any problems or potential problems encountered during the reporting period;

        iii. Actions taken to rectify problems;

        iv. Changes in relevant personnel;

v. Projected work for the next reporting period;

vi. Any proposed revisions to the RFI Schedule of Compliance. Modifications of the RFI Schedule of Compliance are subject to approval by the Department; and,

vii. A summary of any data collected during the reporting period, including:

A. The location of each sampling point identified on a site map;

B. The concentration of each hazardous constituent detected at each sampling point; and,

C. Submittal of RFI Progress Reports, work plans, or other documents during the RFI does not alter the approved RFI Schedule of Compliance.

8. RFI Reports

a. The Permittee shall prepare and submit to the Department an RFI Report within 60 calendar days from the completion of investigation activities in accordance with the approved RFI Schedule of Compliance, if applicable.

b. The RFI Report must provide a detailed description of all required elements of the investigation as described in the most recent edition of the AEIRG.

c. The RFI Report shall be reviewed by the Department in accordance with Permit Condition IV.G.

IV.E. SELECTION OF CORRECTIVE MEASURES AND PERMIT MODIFICATION

1. The Permittee shall develop and submit to the Department a Corrective Measures Implementation (CMI) Plan for any areas of the Permittee's site where hazardous constituents have come to be located at concentrations exceeding those appropriate for the protection of human health and the environment. The CMI Plan must include all applicable elements of the proposed remedy pursuant to the most recent edition of the AEIRG.

2. The CMI Plan shall be submitted to the Department within 120 calendar days following the Permittee's submittal of the RFI Report indicating that hazardous constituents have come to be located at any area of the Permittee's facility, or beyond the facility, at concentrations exceeding those appropriate for the protection of human health and the environment, or within 120 calendar days following notification from the Department that a CMI Plan is required, whichever occurs earlier.

3. The CMI Plan shall be submitted along with a request for permit modification pursuant to ADEM Admin. Code R. 335-14-8-.04(2), and shall include any applicable fees pursuant to ADEM Admin. Code R. 335-1-6. This modification will serve to incorporate the

proposed final remedy, including all procedures necessary to implement and monitor the remedy, into this permit.

4. Within 120 calendar days after this Permit has been modified in accordance with Permit Condition IV.E.3., the Permittee shall demonstrate financial assurance for completing the approved remedy.

IV.F. INTERIM MEASURES (IM)

1. IM Work Plan(s)

   a. Upon notification by the Department, the Permittee shall prepare and submit an Interim Measures (IM) Work Plan for any SWMU or AOC that the Department determines is necessary. IM are necessary in order to minimize or prevent further migration of contaminants and limit human and environmental exposure to contaminants while long-term corrective measures are evaluated and, if necessary, implemented. The IM Work Plan shall be submitted within 30 calendar days of such notification and shall include the elements listed in Permit Condition IV.F.1.b. Such IM may be conducted concurrently with investigations required under the terms of this permit. The Permittee may initiate IM by submitting an IM Work Plan for approval and reporting in accordance with the requirements under Permit Condition IV.F.

   b. The IM Work Plan shall ensure that the IM are designed to mitigate any current or potential threat(s) to human health or the environment and is consistent with and integrated into any long-term solution at the facility. The IM Work Plan shall include: the IM objectives, procedures for implementation (including any designs, plans, or specifications), and schedules for implementation.

   c. The IM Work Plan must be approved by the Department, in writing, prior to implementation. The Department shall specify the start date of the IM Work Plan schedule in the letter approving the IM Work Plan.

   d. The IM Report shall be reviewed by the Department in accordance with Permit Condition IV.G.

2. IM Implementation

   a. The Permittee shall implement the IM in accordance with the approved IM Work Plan.

   b. The Permittee shall give notice to the Department as soon as possible of any planned changes, reductions or additions to the IM Work Plan.

   c. Final approval of corrective action required under ADEM Admin. Code Rule 335-14-5-.06(12), which is achieved through IM, shall be in accordance with ADEM Admin. Code Rule 335-14-8-.04(2) and Permit Condition IV.E.

3. IM Reports

a. If the time required for completion of IM is greater than one year, the Permittee shall provide the Department with Progress Reports at intervals specified in the approved work plan. The Progress Reports shall, at a minimum, contain the following information:

i. A description of the portion of the IM completed;

ii. Summaries of any deviations from the IM Work Plan during the reporting period;

iii. Summaries of any problems or potential problems encountered during the reporting period;

iv. Projected work for the next reporting period; and,

v. Copies of laboratory/monitoring data.

b. The Permittee shall prepare and submit the IM Report to the Department within 90 calendar days of completion of IM conducted under Permit Condition IV.F. The IM Report shall, at a minimum, contain the following information:

i. A description of IM implemented;

ii. Summaries of results;

iii. Summaries of all problems encountered;

iv. Summaries of accomplishments and/or effectiveness of IM; and,

v. Copies of all relevant laboratory or monitoring data, *etc.*, in accordance with Permit Condition I.C.10.

IV.G. SUBMITTALS

1. All work plans, reports, schedules, and other documents ("submittals") required by this permit shall be subject to approval by the Department to assure that such submittals and schedules are consistent with the requirements of this Permit and with applicable regulations and guidance. The Permittee shall revise all submittals and schedules as directed by the Department.

2. The Department will review all submittals in accordance with the conditions of this permit. The Department will notify the Permittee in writing of any submittal that is disapproved, and the basis therefore. If the Department disapproves a submittal, the Department shall: (1) notify the Permittee in writing of the submittal's deficiencies and specify a due date for submission of a revised submittal, (2) revise the submittal and notify the Permittee of the revisions, or (3) conditionally approve the submittal and notify the Permittee of the conditions. Permit Condition IV.H. shall apply only to submittals that have been disapproved and revised by the Department, or that have been disapproved

by the Department, then revised and resubmitted by the Permittee, and again disapproved by the Department.

3. All submittals shall be submitted within the time frame specified by the Department and in accordance with the approved schedule of compliance. Extensions of the due date for submittals may be granted by the Department based on the Permittee's demonstration that sufficient justification for the extension exists.

4. All submittals required by this permit shall be signed and certified in accordance with ADEM Admin. Code Rule 335-14-8-.02(2).

5. Two (2) copies of all submittals shall be provided by the Permittee to the Department in accordance with Permit Condition I.J.

IV.H. DISPUTE RESOLUTION

Notwithstanding any other provision in this permit, in the event the Permittee disagrees, in whole or in part, with the Department's revision of a submittal or disapproval of any revised submittal required by this Part, the following may, at the Permittee's discretion, apply:

1. In the event that the Permittee chooses to invoke the provisions of this section, the Permittee shall notify the Department in writing within 30 calendar days of receipt of the Department's revision of a submittal or disapproval of a revised submittal. Such notice shall set forth:

   a. The specific matters in dispute;

   b. The position the Permittee asserts should be adopted as consistent with the requirements of this permit;

   c. The basis for the Permittee's position; and,

   d. Any matters considered necessary for the Department's determination.

2. The Department and the Permittee shall have additional 30 calendar days from the Department's receipt of the notification provided for in Permit Condition IV.H.1. to meet or confer to resolve any disagreement.

3. In the event agreement is reached, the Permittee shall submit and implement the revised submittal in accordance with and within the time frame specified in such agreement.

4. If agreement is not reached within the 30-day period, the Department will notify the Permittee in writing of his/her decision on the dispute, and the Permittee shall comply with the terms and conditions of the Department's decision in the dispute. For the purposes of this provision in this permit, the responsibility for making this decision shall not be delegated below the Land Division Chief.

5. With the exception of those conditions under dispute, the Permittee shall proceed to take any action required by those portions of the submission and of this permit that the Department determines are not affected by the dispute.

Table IV.1

The following Solid Waste Management Unit(s) (SWMU) and/or Area(s) of Concern (AOC) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs requiring a RCRA Facility Investigation (RFI) and/or remediation:

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU-1*	Final Effluent Control (FEC) Pond Dredge Disposal Site	This unit managed D001, K060, K062, and F002 waste	Groundwater, soil, surface soil, surface water
SWMU-2*	Former Landfill Hill 60	This unit managed D001 and F002 waste.	Groundwater, soil, surface water
SWMU-3*	Dolomite Dredge Waste Pile Upper Dolomite Pond	This unit managed D001 and F002 waste.	Groundwater, soil, surface water
SWMU-4*	Construction Debris Landfill	This unit managed D001, F002, and K060	Groundwater, soil, surface water
SWMU-5*	Sheet Mill Rubble Pile	This unit managed D001, F002, and K060	Groundwater, soil, surface water
SWMU-10*	Former Tar Decanter Sludge Landfill	This unit managed K087.	Groundwater, soil, surface water
SWMU-13*	Former Injection Well	This unit managed K062.	Groundwater, soil, surface water
SWMU-15*	Former Refractory Brick Landfill	This unit managed D006 and D008	Groundwater, soil, surface soil, surface water
SWMU-16*	Former Drum Storage Area No. 1	None	Groundwater, soil, surface soil, surface water
SWMU-23*	Exum Materials Management Area	This unit K060 and K087	Groundwater, soil, surface soil, surface water
SWMU-25*	Former Coke Plant Wastewater System	This unit managed D004, K060, Cyanide, Naphthalene, and Phenol	Groundwater, soil, surface water
SWMU-26*	Blast Furnace No. 7 Quench/Scrubber Water Treatment Plant	This unit managed D006 and D008	Groundwater, soil, surface water
SWMU-27*	Blast Furnace No. 8 Quench/Scrubber Water Treatment Plant	This unit managed D006 and D008	Process water treatment plant
SWMU-28*	Former Emergency Settling Basin for Process Water Treatment Plant for Blast Furnace No. 7	This unit managed D006 and D008	Groundwater, soil, surface water

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU-30*	QBOP Quench/Scrubber Water Treatment Plant	This unit managed D006	Groundwater, soil, surface soil, surface water
SWMU-33*	Dolomite Settling Ponds	This unit managed D006 and D008.	Groundwater, soil, surface soil, surface water
SWMU-35*	Former Sump No. 3	This unit managed K062	Groundwater, soil, surface water
SWMU-36*	No. 4 Galvanizing Line Wastewater Pretreatment Sump	This unit managed heavy metals such as chromium and lead	Groundwater, soil, surface water
SWMU-37*	Former Coke Plant Impoundments	This unit managed D004, K060, Cyanide, Naphthalene, and Phenol	Groundwater, soil, surface water
SWMU-38*	Former Mill Scale Storage Area	None	Groundwater, soil, surface soil, surface water
SWMU-44*	FEC Pond	This unit managed D004, Cyanide, Naphthalene, and Phenol	Groundwater, soil, surface soil, surface water
SWMU-48*	Former Solidification Basin	This unit managed D008	Groundwater, soil, surface water
SWMU-49*	Temporary Baghouse Dust Staging Area	This unit managed D008	Groundwater, soil, surface water
SWMU-50*	Ensley Slag Recovery Area	None	Groundwater, soil, surface water
SWMU-51*	Birmingham Roll Service Area	LNAPL observed at this unit	Groundwater, soil
AOC-1*	SPL Regeneration Plant	This unit managed K062	Groundwater, soil, surface water
AOC-2*	Ensley Facility	This unit managed K060 and K087	Groundwater, soil, surface water
AOC-3*	Former Coke Plant	This unit managed K060 and K087	Groundwater, soil, surface water
AOC-4*	Wastewater Ditch System	This unit managed K087	Groundwater, soil, surface water
AOC-5B*	Lower Opossum Creek	This unit managed D004, D008, and tar like material	Groundwater, soil, surface water
AOC-5C*	Lower-Lower Opossum Creek	This unit managed D004, D008, and tar like material	Groundwater, soil, surface water
AOC-6*	Stormwater Overflow Area	This unit managed D008 and K062	Groundwater, soil, surface water
AOC 7*	Diversion Ditch	None	Groundwater, soil, surface water

* The RFI for these SWMUs/AOCs is complete. The corrective measure requirements for these SWMUs/AOCs are detailed in Part V of this permit.

Table IV.2

The following Solid Waste Management Unit(s) (SWMU) and/or Area(s) of Concern (AOC) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs requiring no further action at this time:

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU-6	Former Pickle Line Settling Basins	This unit managed D008 and K062	Groundwater, soil, surface water
SWMU-7	Former SPL Neutralization Sump	This unit managed D008 and K062	Groundwater, soil, surface water
SWMU-8	Paint Line Wastewater Treatment Sump	This unit managed paint constituents (heavy metals and solvents)	Groundwater, soil, surface water
SWMU-9	Paint Line container storage area	This unit managed paint constituents (heavy metals and solvents)	Groundwater, soil, surface water
SWMU-12	Closed Impoundment S-22	This unit managed K062	Groundwater, soil, surface water
SWMU-14	Q-BOP slag processing Area	This unit managed D001 and K062	Groundwater
SWMU-17	Former Drum Storage Area No. 2	None	Groundwater, soil, surface water
SWMU-18	Former Coke Plant Wastewater Impoundment	This unit managed D004, Cyanide, Naphthalene, and Phenol	Groundwater, soil, surface water
SWMU-19	Former Wire Mill Impoundment	This unit managed galvanizing waste from a wire mill potentially containing heavy metals - hexavalent chromium/	Groundwater, soil, surface soil, surface water
SWMU-20	Former Overburden Slate Pile	None	Groundwater, soil, surface water
SWMU-21	Former Slate Pile	None	Groundwater, soil, surface water
SWMU-22	Koch Carbon Site	None	Groundwater, soil, surface water
SWMU-24	Former Wastewater Treatment Basin	This unit managed heavy metals and hexavalent chromium.	Groundwater, soil, surface soil, surface water
SWMU-29	Former Wastewater Treatment Plant	None	Groundwater, soil, surface water
SWMU-31	Ladle Metallurgy Facility (LMF) Wastewater Treatment Plant	This unit managed D006, D008, and D011	Groundwater, soil, surface water
SWMU-32	Bloom and Slab Caster Wastewater Treatment Plant	None	Groundwater, soil, surface water
SWMU-34	No. 4 SPL Sump	This unit managed K062	Groundwater, soil, surface water
SWMU-39	Boilers No. 9 and No. 10	None	Groundwater, soil, surface water

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU-40	Oil Recycling Facility	This unit managed D008	Groundwater, soil, surface water
SWMU-41	Scrap Yards	None	Groundwater, soil, surface water
SWMU-42	Tin Mill Transformer Storage Area	This unit managed D006 and D008	Groundwater, soil, surface soil, surface water
SWMU-43	Sheet Mill Transformer Storage Area	This unit managed D006 and D008	Groundwater, soil, surface soil, surface water
SWMU-45	Finishing Mill Ditch	This unit managed D008	Groundwater, soil, surface water
SWMU-46	Finishing Mill Ditch Wastewater Treatment System	This unit managed D008	Groundwater, soil, surface water
SWMU-47	Seamless Pipe Mill Compactor/Dumpster	This unit managed D008	Groundwater, soil, surface water
AOC-5A	Upper Opossum Creek	Includes 4.5 miles of Opossum Creek extending from US Steel Pipe Mill downstream to the US Steel flow weir	Groundwater, sediment, soil, surface water

Table IV.3

The following Solid Waste Management Unit(s) (SWMU) and/or Area(s) of Concern (AOC) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs regulated by Parts I, II, and III of this permit.

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU-11	Closed impoundment (surface impoundment closed as a landfill)	This unit managed D001, K060, K062, K087, and U226	Groundwater, soil, subsurface gas, surface water

PART V

CORRECTIVE MEASURES IMPLEMENTATION

V.A. APPLICABILITY

The conditions of this Part apply to SWMUs and AOCs identified in Table V.1.

V.B. GENERAL CONDITIONS

1. The Permittee is required to perform corrective measures for the SWMUs and AOCs identified in Condition V.A. The approved remedy for these defined units, waterway areas, or land parcels, includes any and all actions set forth in this permit and in the approved Interim Measures Plans, Corrective Measures Studies (CMSs), and Corrective Measures Implementation (CMI) Plans approved by the Department, as noted below:

Applicable SWMU/AOC	CMS/CMI	Approval Date
AOC-5A	Upper Opossum Creek CMI WP	November 28, 2005
AOC-2	Former Ensley Works CMI WP	June 12, 2007
AOC-5B	Lower Opossum Creek CMI WP	May 2, 2016*
AOC-5C	Lower-Lower Opossum Creek CMI WP	May 2, 2016*
SWMUs 1, 2, 3, 4, 5, 10, 13, 15, 16, 25, 26, 27, 28, 30, 33, 35, 36, 37, 38, 44, 48, 49, 50, 51, AOCs 1, 2, 3, 4, 6, 7	Fairfield Works CMI WP AOC 3 CMI WP	September 17, 2019
SWMU 23	Exum Material Management Area CMI WP	XX/XX/XXXX

* CMI Plan developed and submitted by Beazer East, Inc. on July 10, 2015, as modified by subsequent amendment dated August 2015. The Corrective Measures Implementation Documentation Report (Report), which was submitted by Beazer East, Inc., was approved in a letter dated August 8, 2018. The letter also stated that Beazer East, Inc. should conduct post-construction monitoring, maintenance, and reporting in accordance with the Report and CMI Plan.

2. Remedial Cleanup Levels

   Upon approval, pursuant to Condition IV.E., of the CMI Plan designating applicable cleanup level(s), the cleanup level(s) for the areas specific to the CMI Plan will be deemed to be a condition of this permit.

3. Groundwater Monitoring and Remediation

   Where required pursuant to Conditions V.B.1. and V.C. of this permit, the Permittee shall comply with the general groundwater monitoring requirements of Part III of this permit.

4. Land Use Controls

Where required pursuant to Conditions V.B.1. and V.C. of this permit, the Permittee shall establish appropriate land use controls to achieve protection of human health and the environment. The Permittee shall comply with Conditions V.B.5. and V.B.6. of this permit when implementing corrective measures requiring land use controls. Where the owner of such property will not allow an environmental covenant to be imposed, the Permittee shall notify the Department within 14 calendar days of receipt of written notification by the property owner. In such cases, the Department may allow the Permittee to propose an alternate area-specific land use control, subject to the Department's review and approval.

5. Survey Plat

For corrective measures where residual concentrations of contaminants will remain in-place at levels greater than those appropriate for unrestricted land use, or for corrective measures that rely on land use controls, the Permittee must:

a. Within 90 calendar days following the effective date of a permit modification addressing remedy selection, submit to the local zoning authority, or the authority with jurisdiction over local land use, and to the Department, a survey plat indicating the location and dimensions of the SWMUs, AOCs, and capped or partially remediated areas with respect to permanently surveyed benchmarks, the locations of sampling points, and the concentrations of hazardous constituents detected. This plat must be prepared and certified by a professional land surveyor registered in the State of Alabama. The plat must be filed with the local zoning authority or the authority with jurisdiction over local land use and must contain a note, prominently displayed, which states the Permittee's obligation to limit the property to the specified non-residential uses.

b. Maintain the survey plat as described in Condition V.B.5.a. of this permit and in the CMI Plan until the Permittee has demonstrated, to the satisfaction of the Department, that the levels of hazardous constituents in all contaminated media are within limits appropriate for unrestricted residential land uses.

6. Environmental Covenant

No later than the submission of the survey plat required in Condition V.B.5., the Permittee must:

a. Record in the probate judges office of the county in which the property is located or a portion thereof an environmental covenant in accordance with ADEM Admin. Code R. 335-5 that will in perpetuity notify any potential purchaser of the property that:

i. The land is contaminated with hazardous constituents in concentrations that exceed residential standards;

ii. The use of the property is restricted by this permit for certain residential, municipal, or industrial purposes and may lead to an increased risk of exposure to hazardous constituents depending upon the activities initiated at the site. Such activities may yield an increased level of human health risk to the owner;

iii. The potential purchaser or entity that desires to work in the contaminated area should notify the Permittee before mobilizing to the area covered by the land use control.

b. Submit to the Department a certification, signed by the Permittee in accordance with Permit Condition I.C.11., that the environmental covenant specified in this part has been performed. This certification must include a copy of the document in which the notation has been placed.

c. Maintain the environmental covenant described in Permit Condition V.B.6. until the Permittee has demonstrated, to the satisfaction of the Department, that the levels of hazardous constituents in all contaminated media are within limits appropriate for unrestricted land uses.

7. Security

Security measures, where required by Conditions V.B.1. and V.C. of this permit, will be conducted in accordance with ADEM Admin. Code R. 335-14-5-.02(5) and as prescribed in the approved CMI Plan.

8. Inspection

Where corrective measures addressed in Conditions V.B.1. include provisions to cap in place or partially remediate properties or land areas, whether owned or not owned by the Permittee, the Permittee shall specify inspection protocols on a scheduled basis to ensure continued integrity of the remedy and to ensure that land use remains appropriately restricted per the environmental covenant established pursuant to Permit Condition V.B.6. Inspection provisions shall be as prescribed in the approved CMI Plan

V.C. AREA SPECIFIC CONDITIONS (RESERVED)

V.D. CORRECTIVE MEASURES IMPLEMENTATION (CMI) REPORTS

1. CMI Progress Reports

If the time required to complete implementation of a specific set of corrective measures, as described in the Department-approved CMI Plan approved by the,

is greater than 180 calendar days, the Permittee shall provide ADEM with progress reports according to the schedule approved by ADEM in the CMI Plan. If no schedule has been approved as part of the associated plan, progress reports shall be submitted at least quarterly. The progress reports shall, at a minimum, contain the following information:

a. A description of the portion of CMI completed;

b. Summaries of and deviations from the approved CMI during the reporting period;

c. Summaries of current and potential problems, including recommended solutions and alternatives as well as corrective actions undertaken;

d. Any monitoring data (soil, air, dust, water) collected for any reason during the construction period for the purposes of monitoring potential for human and ecological exposure; and,

e. Projected work for the next period and impacts to the approved schedule.

2. Final CMI Reports

Upon completion of construction of corrective measures systems, implementation of land use controls, interim removal actions, or other short-term activities required by this permit and/or the approved CMI Plan, the Permittee shall submit to the Department a Final CMI Report containing, at a minimum, the following:

a. A description of activities completed;

b. For cap and cover remedies, as-built construction drawings presenting the final in-place three-dimensional location of contaminated material. A plan view of the remediated areas shall be presented in addition to a cross section of the in-place capped areas;

c. Hazardous waste manifests indicating the handling of any excavated material that has been shipped off-site to a Department-approved, certified landfill;

d. For remedies involving land use controls, a copy of the survey plat and environmental covenant required by Condition V.B. of this permit;

e. Monitoring data (soil, air, dust, water) collected for any reason during the construction period for the purposes of monitoring potential for human and ecological exposure; and

f. Certification, prepared in accordance with ADEM Admin. Code Rule 335-14-8-02 (2)(d) by the Permittee and an independent professional engineer registered in the State of Alabama, that the corrective measures implementation phase (*i.e.,* construction) required by this permit is complete and that the approved system and/or facilities are

ready for operation in accordance with the intended design (*i.e.*, CMI Plan).

3. Corrective Measures (CM) Effectiveness Reports

a. For corrective measures that have been fully implemented and where the corrective measures system must operate for a period of time to achieve cleanup goals or levels, the Permittee shall submit CM Effectiveness Reports annually, unless otherwise approved by the Department, beginning 180 calendar days following the Department's approval of the Final CMI Report. The CM Effectiveness Reports shall include, at a minimum, the following information for each SWMU and/or AOC included in the report:

i. A detailed narrative presenting an evaluation of the effectiveness of the selected remedy;

ii. Summaries of compliance with and progress toward achieving cleanup goals;

iii. Any significant revisions, adjustments, or proposed modifications to the selected remedy;

iv. Tabulated environmental sampling and monitoring data including, but not limited to, groundwater quality, elevation data, and a graphical representation of all constituents detected during each sampling event from recovery wells, monitoring wells, drinking water wells, and other locations;

v. Chain of custody, field reports, and laboratory data sheets to include the date of collection, the date the sample was extracted, and the date of sample analysis for samples collected during the reporting period;

vi. Any monitoring data (soil, air, dust, water) collected for any reason during the post-construction period for the purposes of monitoring potential for human and ecological exposure;

vii. Isoconcentration maps depicting the distribution of parameters for each sampling event;

viii. Time versus concentration plots for each monitoring parameter for each recovery well and a representative number of effectiveness wells;

ix. Tabulated volumetric data on groundwater pumped and pumping rates (monthly and cumulative) for each recovery well;

x. Records of any groundwater recovery system operation time, including shutdown periods, not including any minor (less than 24 hours) shutdowns for repairs, maintenance, etc.;

xi. Potentiometric surface maps;

xii. Description of land use during the reporting period at the designated area requiring corrective measures; and,

xiii. Findings of the Permittee's investigation into the continued effectiveness of land use controls per Condition V.B.

b. If, at any time, the Permittee determines that any remedy selection specified in Condition V.B or V.C. of this permit no longer satisfies the applicable requirements of ADEM Admin. Code R. 335-14-5-.06(12) or this permit for releases of hazardous waste or hazardous constituents originating from SWMUs or AOCs, the Permittee must, within 90 calendar days, submit an application for a permit modification, pursuant to Permit Condition I.I, to make any appropriate changes to the CMI Plan.

c. The application for changes in the CMI Plan, including changes in inspection and monitoring provisions of the CMI Plan, shall be submitted as an application for a permit modification pursuant to the requirements of ADEM Admin. Code R. 335-14-8-.04.

4. Final Report of Corrective Measures

Within 90 calendar days following attainment of cleanup levels or goals as outlined in this Permit and the approved CMI Plan, the Permittee shall submit to the Department a Final Report of Corrective Measures (FRCM). The FRCM shall contain a certification by the Permittee and an independent professional engineer registered in the State of Alabama that all remedial measures required by this permit and the approved CMI Plan has been completed. The FRCM shall outline any procedures and schedules for dismantling of corrective measures systems, groundwater monitoring or recovery systems, removal of land use controls, and any other remedial systems or controls required by this permit or the approved CMI Plan.

Table V.1.

The following Solid Waste Management Unit(s) (SWMUs) and/or Area(s) of Concern (AOCs) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs requiring Corrective Measures.

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU-1	Final Effluent Control (FEC) Pond Dredge Disposal Site	This unit managed D001, K060, K062, and F002 waste	Groundwater, soil, surface soil, surface water
SWMU-2	Former Landfill Hill 60	This unit managed D001 and F002 waste.	Groundwater, soil, surface water
SWMU-3	Dolomite Dredge Waste Pile Upper Dolomite Pond	This unit managed D001 and F002 waste.	Groundwater, soil, surface water
SWMU-4	Construction Debris Landfill	This unit managed D001, F002, and K060	Groundwater, soil, surface water
SWMU-5	Sheet Mill Rubble Pile	This unit managed D001, F002, and K060	Groundwater, soil, surface water
SWMU-10	Former Tar Decanter Sludge Landfill	This unit managed K087.	Groundwater, soil, surface water
SWMU-13	Former Injection Well	This unit managed K062.	Groundwater, soil, surface water
SWMU-15	Former Refractory Brick Landfill	This unit managed D006 and D008	Groundwater, soil, surface soil, surface water
SWMU-16	Former Drum Storage Area No. 1	None	Groundwater, soil, surface soil, surface water
SWMU-23	Exum Materials Management Area	This unit K060 and K087	Groundwater, soil, surface soil, surface water
SWMU-25	Former Coke Plant Wastewater System	This unit managed D004, K060, Cyanide, Naphthalene, and Phenol	Groundwater, soil, surface water
SWMU-26	Blast Furnace No. 7 Quench/Scrubber Water Treatment Plant	This unit managed D006 and D008	Groundwater, soil, surface water
SWMU-27	Blast Furnace No. 8 Quench/Scrubber Water Treatment Plant	This unit managed D006 and D008	Process water treatment plant
SWMU-28	Former Emergency Settling Basin for Process Water Treatment Plant for Blast Furnace No. 7	This unit managed D006 and D008	Groundwater, soil, surface water
SWMU-30	QBOP Quench/Scrubber Water Treatment Plant	This unit managed D006	Groundwater, soil, surface soil, surface water

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU-33	Dolomite Settling Ponds	This unit managed D006 and D008.	Groundwater, soil, surface soil, surface water
SWMU-35	Former Sump No. 3	This unit managed K062	Groundwater, soil, surface water
SWMU-36	No. 4 Galvanizing Line Wastewater Pretreatment Sump	This unit managed heavy metals such as chromium and lead	Groundwater, soil, surface water
SWMU-37	Former Coke Plant Impoundments	This unit managed D004, K060, Cyanide, Naphthalene, and Phenol	Groundwater, soil, surface water
SWMU-38	Former Mill Scale Storage Area	None	Groundwater, soil, surface soil, surface water
SWMU-44	FEC Pond	This unit managed D004, Cyanide, Naphthalene, and Phenol	Groundwater, soil, surface soil, surface water
SWMU-48	Former Solidification Basin	This unit managed D008	Groundwater, soil, surface water
SWMU-49	Temporary Baghouse Dust Staging Area	This unit managed D008	Groundwater, soil, surface water
SWMU-50	Ensley Slag Recovery Area	None	Groundwater, soil, surface water
SWMU-51	Birmingham Roll Service Area	LNAPL observed at this unit	Groundwater, soil
AOC-1	SPL Regeneration Plant	This unit managed K062	Groundwater, soil, surface water
AOC-2	Ensley Facility	This unit managed K060 and K087	Groundwater, soil, surface water
AOC-3	Former Coke Plant	This unit managed K060 and K087	Groundwater, soil, surface water
AOC-4	Wastewater Ditch System	This unit managed K087	Groundwater, soil, surface water
AOC-5B	Lower Opossum Creek	This unit managed D004, D008, and tar like material	Groundwater, soil, surface water
AOC-5C	Lower-Lower Opossum Creek	This unit managed D004, D008, and tar like material	Groundwater, soil, surface water
AOC-6	Stormwater Overflow Area	This unit managed D008 and K062	Groundwater, soil, surface water
AOC 7	Diversion Ditch	None	Groundwater, soil, surface water

PART VI

SUMMARY OF DEADLINES

The summary information provided herein is intended only as a guide to the requirements of this permit. It is not intended to be all inclusive, nor is it intended to be used as a substitute for the full text of this permit.

PERMIT CONDITION	ITEM	DUE DATE
I.C.2.b.	Reapply for a renewal	180 calendar days before the expiration of the current permit.
I.C.12.	Give notice to the Department of any planned physical alterations or additions to the permitted facility and any solid waste management units.	As soon as possible
I.C.12.	Report any noncompliance with this permit that may endanger human health or the environment.	Orally within 24 hours from the time the Permittee becomes aware of the circumstances. Written submission shall also be provided within 5 calendar days of the time that the Permittee becomes aware of the circumstances
I.F.	Waste Minimization Certification	Annually
I.G.	Update cost estimates	No later than 30 calendar days after the Department has approved a modification to the Closure Plan, Post-Closure Plan, or Corrective Action Plan, or any other plan required or referenced by this permit, if the change in the plan results in an increase in the amount of the cost estimate and annually as required by ADEM Admin. Code Rules 335-14-5-.08(3)(b), (5)(b), and (10)(b)
I.I.	Submit a written request for a permit modification pursuant to the requirements of ADEM Admin. Code Rule 335-14-8-.04(2).	At least 60 calendar days prior to a proposed change in facility design or operation.
II.C.2	Inspect closed unit(s).	At least weekly, after storms, and in accordance with the inspection schedule.
III.B.1.a.iii.	Notification of damaged groundwater monitoring wells.	Immediately in writing. The well must be repaired within 30 calendar days of damage, and repair report must be submitted within 30 calendar days of repair.
III.B.1.d.	Install additional groundwater monitoring wells	As necessary to assess changes in the rate and extent of any plume of contamination, or as otherwise deemed necessary. Note: a permit modification request must be submitted within 90 calendar days prior to installation of additional groundwater monitoring well(s).
III.B.2.a.	Determine groundwater surface elevation.	At least semi-annually and each time a well is sampled.
III.B.2.b.	Determine groundwater flow rate and direction.	At least annually.

PERMIT CONDITION	ITEM	DUE DATE
III.B.6.b.	Submit groundwater monitoring report	Within 60 calendar days of the first sampling event and annually thereafter.
III.B.6.c.	Submit progress reports.	Within 90 calendar days after the effective date of this permit and quarterly thereafter. See permit condition for start/stop/resume provisions.
III.E.2.b.	Implement corrective action plan	No later than 120 calendar days after the effective date of this permit.
III.E.3.a.	Sample all background, point of compliance, and effectiveness wells shown in Table III.1 of this permit and analyze for the constituents listed in Table III..2. of this permit.	Semi-annually for SWMU-11 (Unit D-6) and annually for AOC-3 beginning within 120 calendar days of the effective date of this permit and continuing through the end of the compliance period.
III.E.3.b.	Sample all background, point of compliance, effectiveness, and boundary wells shown in Table III.1 of this permit and analyze for the constituents in Table III.3 of this permit	Annually beginning within 120 calendar days of the effective date of this permit and continuing through the end of the compliance period.
III.E.3.c.	Sample all background, point of compliance, effectiveness, and boundary monitoring wells shown in Table III.1. of this permit and analyze for temperature (degrees F or C), specific conductance (Mhos/cm), and pH (standard units)	Each time the well is sampled
III.E.4.a.	Submit corrective action effectiveness reports.	Annually within 60 calendar days of each annual anniversary of this permit after corrective action is initiated and until corrective action is completed.
IV.B.1.	Notify the Department, in writing, of the discovery of any additional AOCs	Within 15 calendar days of discovery
IV.B.2.	Notify the Department, in writing, of the discovery of any additional SWMUs	Within 15 calendar days of discovery
IV.B.3.	Submit a SWMU Assessment Report (SAR) for each SWMU identified under IV.B.2.	Within 90 calendar days of notification.
IV.C.1.	Notify the Department, in writing, of any newly discovered release(s) of hazardous waste or hazardous constituents from SWMUs or AOCs discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means.	Within 15 calendar days of discovery
IV.D.7.	Submit RFI Progress Reports.	Monthly beginning in the second month following the initiation of the RFI

PERMIT CONDITION	ITEM	DUE DATE
IV.D.8.	Submit RFI Report	Within 60 calendar days from the completion of investigation activities.
IV.E.2.	Submit CMI Plan	Within 120 calendar days following the Permittee's submittal of the RFI Report indicating that hazardous constituents have come to be located at any area of the Permittee's facility, or beyond the facility, at concentrations exceeding those appropriate for the protection of human health and the environment, or within 120 calendar days following notification from the Department that a CMI Plan is required, whichever occurs earlier.
IV.E.4.	Demonstrate financial assurance for completing the approved remedy.	Within 120 calendar days after this Permit has been approved.
IV.F.1.	Submit IM Work Plan	Within 30 calendar days upon notification by the Department.
IV.F.3.	Submit IM Report	Within 90 calendar days of completion of IM.
V.B.5.a.	Submit to the local zoning authority, or the authority with jurisdiction over local land use, and to the Department, a survey plat indicating the location and dimensions of the SWMUs, AOCs, and capped or partially remediated areas with respect to permanently surveyed benchmarks, the locations of sampling points, and the concentrations of hazardous constituents detected	Within 90 calendar days following the effective date of a permit modification addressing remedy selection.
V.B.6.a.	Record environmental covenant	No later than the submission of the survey plat required in Condition V.B.5.
V.B.6.b.	Submit to the Department a certification that the environmental covenant has been performed.	No later than the submission of the plat required in Condition V.B.5.
V.D.1.	Submit CMI Progress Reports if the time required to complete implementation of a specific set of corrective measures is greater than 180 days	At least quarterly
V.D.2.	Submit Final CMI Report	Upon completion of construction of corrective measures
V.D.3.	Submit Corrective Measures Effectiveness Reports	Annually beginning 180 calendar days following the Department's approval of the Final CMI Report
V.D.4.	Submit a Final Report of Corrective Measures (FRCM)	Within 90 calendar days following attainment of cleanup levels or goals

AECOM Imagine it. Delivered.

Submitted to
United States Steel Corporation
Penn Liberty Plaza 1
1350 Penn Ave., Ste. 200
Pittsburgh, PA 15222

Submitted by
AECOM
1000 Corporate Centre Dr.,
Ste 250
Franklin, TN 37067
August 30, 2019 (REV0 - 07/27/2021)

United States Steel Corporation

Exum Materials Management Area Corrective Measures Implementation Plan

EPA ID No. ALD 002 904 506

United States Steel Corporation
Fairfield Works Facility
5700 Valley Road
Fairfield, Alabama

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List of Acronyms

ADEM	Alabama Department of Environmental Management
AECOM	AECOM Technical Services, Inc.
AOC	Area of Concern
AOC	Area of Contamination (per U.S. EPA)
ARBCA	Alabama Risk-Based Corrective Action
bgs	Below Ground Surface
CBMPP	Construction Best Management Practices Plan
CCR	Current Conditions Report
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
COI	Chemical of Interest
CSM	Conceptual Site Model
CR	Cancer Risk
EPC	Exposure Point Concentration
FRCM	Final Report of Corrective Measures
GPS	Global Positioning System
HI	Hazard Index
HMW	High Molecular Weight
HQ	Hazard Quotient
ILF	Industrial Landfill
LUC	Land Use Control
NPDES	National Pollution Discharge Elimination System
NWP	Nationwide Permit
PAHs	Polynuclear Aromatic Hydrocarbons
QA	Quality Assurance
QCP	Qualified Professional
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-based Concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SPLP	Synthetic Precipitation Leaching Procedure
SWMU	Solid Waste Management Unit
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
UECP	Uniform Environmental Covenants Program
USACE	United States Army Corp of Engineers
U.S. EPA	United States Environmental Protection Agency
U. S. Steel	United States Steel corporation
VOC	Volatile Organic Compound

1 Introduction

United States Steel Corporation (U. S. Steel) has retained AECOM Technical Services, Inc. (AECOM) to develop a Corrective Measures Implementation Plan (CMIP) for the U. S. Steel Fairfield Works Facility located at 5700 Valley Road, Fairfield, Jefferson County, Alabama (Fairfield Works or the site) (see **Figure 1-1**). Exum Materials Management Area (Exum) was identified as one of 51 solid waste management units (SWMUs) associated with the U. S. Steel Fairfield Works facility (Fairfield Works). Exum was designated as SWMU 23. The Alabama Department of Environmental Management (ADEM) issued RCRA Post-Closure Care Permit No. ALD 002 904 506 (the Permit) to U. S. Steel on February 8, 1999, as modified on June 7, 2017 (ADEM, 2017a) that stipulates corrective action requirements for SWMUs and Areas of Concern (AOCs) identified at Fairfield Works. Phase I and Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFI) have been completed at Exum and approved by ADEM. Based on results of the RFI, and consistent with the Fairfield Works CMIP submitted separately (AECOM, 2019a), corrective measures are recommended for Exum. The Permit provides a general outline of activities necessary to satisfy corrective action requirements and lists the SWMUs and AOCs at Fairfield Works, including Exum. This document represents the CMIP for Exum.

1.1 General Description

Exum is located approximately one-mile northwest of Fairfield Works near the communities of Pleasant Grove, Exum, and Wylam (see **Figure 1-1**) and is accessible by both roadway and rail. The Exum facility is bounded on the north by New Mulga Loop Road; on the east by Tin Mill Road/10th Avenue; on the south by Pleasant Grove Road; and on the west by a wetland area associated with Camp Branch and an active railroad line. A chain-link fence surrounds the entire perimeter of the Exum facility which is secured with automated locking gates. U. S. Steel Security routinely patrols the perimeter fence.

Exum consists of approximately 230 acres and was previously used for storage of raw materials used by Fairfield Works, the storage of co-products of the iron and steel making operations, and management of non-hazardous wastes (blast furnace and QBOP sludge, dust, and other plant waste) generated at Fairfield Works. Operations at Exum began in the early 1940s to store co-product slag produced at Fairfield Works. Slag constitutes the largest volume of fill material at Exum and was used to contour the Upper and Lower Pads for material storage. Exum is currently inactive and residual raw materials and other co-products previously stockpiled on the Upper and Lower Pads have been removed and are no longer present with the exception of existing mill scale stored on the Lower Pad for recycling. More detailed descriptions of Exum are presented in the Current Conditions Report (CCR) developed by Fleming & Blair for the USEPA in June 1998 and the Exum RFI Work Plan (URS, 2011).

1.2 Project Background

An Exum RFI Work Plan was submitted to ADEM on August 31, 2011 (URS, 2011). For the purpose of the Exum Phase I RFI, Exum was divided into five primary investigation areas identified as follows:

- Upper Pad;
- Lower Pad;
- Upper and Lower Impoundments;
- BF/QBOP Sludge Disposal Area; and
- Camp Branch and associated wetland area.

Each of these areas is shown on **Figure 1-2**. Phase I RFI activities were initiated in November 2011 and the last of four quarterly groundwater sampling events was completed in August 2012. Results were reported in the Exum Phase I RFI Report (URS, 2012) and an Addendum Groundwater Investigation Report (URS, 2013). The Exum Phase I RFI reports were approved by ADEM via letter dated January 27, 2017.

Based on the results of the Phase I RFI, no further action was recommended for the Upper and Lower Pads, BF/QBOP Sludge Disposal Area, and Camp Branch. Additional delineation activities were recommended for the Upper and Lower Impoundments to evaluate the vertical and horizontal extent of materials previously disposed in these areas. U. S. Steel received ADEM comments regarding the Exum Phase I RFI Report via letter dated March 22, 2013 which identified data gaps and recommended additional soil borings and monitoring wells for the Upper and Lower Pads to adequately characterize these areas.

In the Response to ADEM Comments dated June 19, 2013, U. S. Steel agreed with ADEM recommendations that additional investigation activities were needed to complete data gaps identified in the Exum Phase I RFI. Proposed investigation activities for a Phase II RFI were presented to ADEM during a January 25, 2017 meeting between ADEM and U. S. Steel held at ADEM's central office in Montgomery, AL. ADEM approved U. S. Steel's comments and proposed scope of work via letter dated January 27, 2017.

Subsequent installation of Exum Phase II RFI soil borings and monitoring wells was completed in May 2017. Monitoring well locations are shown in **Figure 1-3**. Groundwater samples were collected from existing and new monitoring wells during June and September 2017. The Exum Phase II RFI Report dated January 24, 2018, as revised April 13, 2018 to include March 21, 2018 ADEM comments (Revision 1 Report) documented the Exum Phase II RFI field activities and findings.

Based on findings documented in the Revision 1 Report, additional investigation activities were recommended in the Upper Impoundment and Pipe Mill Varnish Area. U. S. Steel submitted the Additional Investigation Activities Work Plan to ADEM dated June 20, 2018. ADEM approved the Additional Investigation Activities Work Plan via email correspondence dated July 9, 2018. Activities approved in the work plan included additional investigation of the Upper Impoundment, Pipe Mill Varnish Area, and evaluation of the soil to groundwater migration pathway. The results of the additional investigation activities were incorporated into the Exum Phase II RFI Report, Revision 2 (Revision 2 Report) (AECOM, 2019b). The Phase II RFI Report was approved by ADEM via letter dated May 6, 2019.

1.3 Investigation Area Descriptions

1.3.1 Upper Pad

The Upper Pad consists of approximately 60 acres and was used for storage of raw materials used by Fairfield Works, including iron and manganese pellets and limestone. Mill scale was periodically staged on the Upper Pad for grading and sent off site for recycling and beneficial reuse.

Portions of the Upper Pad were historically used for disposal of filter cake from the Fairfield Works wastewater treatment and sludge dewatering operations (No. 8 Blast Furnace, Q-Bop furnaces, Pipe Mill, and Tin Mill Wastewater Treatment Plant), non-combustible plant wastes including brick, mortar and construction debris, and railroad ties. A solidified varnish waste from the Pipe Mill was also disposed at the Upper Pad and is contained in an isolated area secured with a chain-link fence (Fleming & Blair, 1998). Through chemical and physical analysis, waste material disposed in the Pipe Mill Varnish Area does not exhibit characteristics of a hazardous waste. Based on this information and generator knowledge that the material disposed in the area was not considered hazardous, the current designation of the Pipe Mill Varnish Area as a hazardous waste storage area should be redesignated as non-hazardous, as stated in the Exum Phase II RFI Report, Revision 2 approved by ADEM.

Two stormwater depositional areas were identified on the eastern side of the Upper Pad. Based on surface drainage patterns, stormwater runoff from the former wastewater treatment sludge management area, located in the southern portion of the Upper Pad, collects in these areas. Stormwater from these areas and the eastern portion of the Upper Pad generally flows east to a large drainage culvert that ultimately flows under the Upper Pad west to Camp Branch.

1.3.2 Upper and Lower Impoundments

According to the 1996 RFA, the earthen impoundments were constructed in 1973 and are unlined (PRC, 1996). The Upper and Lower Impoundments were previously known as the East and West Impoundments, respectively. The Upper Impoundment reportedly received waste by-products of the Fairfield Works Coke Plant including decanter tank tar sludge (K087) and ammonia still lime sludge (K060) prior to 1982 when coking operations at Fairfield Works ceased (Fleming & Blair, 1998). The Upper Impoundment receives stormwater runoff from the northern portion of the Upper Pad and retains water.

During a May 2011 site reconnaissance, a tar/oil like substance was observed on the northern shoreline and slope of the Upper Impoundment (URS, 2011).

The Lower Impoundment reportedly received filter cake from the Tin Mill wastewater treatment plant and did not receive hazardous waste (Fleming & Blair, 1998). During the May 2011 site reconnaissance, isolated areas of standing water were observed in the Lower Impoundment. An access road to the Lower Pad bisects the two impoundments. The Lower Pad is topographically downgradient of the Upper Impoundment. The lower elevation of the Lower Pad can be attributed to a north-south trending high angle fault that traverses the eastern portion of Exum in the general vicinity of the Upper and Lower Impoundments (Fleming & Blair, 1998). Consistent with the Lower Pad, the Lower Impoundment is likely located on the downthrown side of the fault.

Stormwater from the northernmost area of the Upper Pad is contained in the Upper Impoundment. Limited surface water runoff from the Upper Pad flows to the Lower Impoundment. Neither impoundment discharges to Camp Branch. During the May 2011 site reconnaissance and November 2011 field RFI, URS did not observe any hydraulic connectivity between the two units. This was primarily based on the absence of significant water in the Lower Impoundment versus the Upper Impoundment. Due to the interpreted topographical gradient between the two units, it would appear that water in the Upper Impoundment would flow freely to the Lower Impoundment if they were connected. It is possible the high angle fault prohibits communication between the two units.

1.3.3 Lower Pad

The Lower Pad consists of approximately 30 acres (Fleming & Blair, 1996) and is located in the northernmost portion of Exum. Materials stored and managed on the Lower Pad consisted primarily of mill scale and flue dust generated at Fairfield Works. These materials were managed for recycling and beneficial reuse.

1.3.4 BF/QBOP Sludge Disposal Area

The BF/QBOP Sludge Disposal Area (also referred to as the sludge disposal area) was used for disposal of blast furnace and QBOP sludge, dust, and other plant wastes generated during the manufacturing process at Fairfield Works. The BF/QBOP sludge disposal area consists of approximately 20 acres based on aerial photography (see **Figure 1-2**) and has been in use since approximately 2000. The sludge disposal area was initially intended for short-term disposal. Waste materials disposed in the sludge disposal area were routinely submitted for toxicity characteristic leaching procedure (TCLP) analysis for waste characterization and disposal purposes. According to Fairfield Works personnel, Fairfield Works stopped using the sludge disposal area on October 1, 2011 (URS, 2012).

1.3.5 Camp Branch

Camp Branch is a perennial stream that forms the western boundary of Exum. Surface water runoff from the Lower Pad and western portions of the Upper Pad discharges into Camp Branch. Surface water runoff from the eastern portion of the Upper Pad and BF/QBOP Sludge Disposal Area drains towards the east, where runoff is contained by existing topography and is transported by an unnamed tributary to drainage culverts that flow westerly beneath the Upper Pad and also discharge into Camp Branch. Camp Branch ultimately discharges to Bay View Lake located approximately two miles north of Exum (URS, 2011).

2 Description of Current Situation

As approved in the Exum Phase I RFI Work Plan (URS, 2011), U. S. Steel applied a tiered risk-based approach at Exum. The risk-based approach was completed in accordance with U.S. EPA Risk Assessment Guidance for Superfund (RAGS) (U.S. EPA, 1989, 2004) for the evaluation of potential human health risks. The approach was integrated with current versions of Alabama Risk Based Corrective Action (ARBCA) guidance, as updated by ADEM during the various RFI phases (ADEM 2008, 2017).

The primary objective of the risk-based phased approach was to focus the investigation and corrective actions, if deemed necessary, on those chemicals of interest (COIs) and areas that most likely present a potential unacceptable risk to human health and/or the environment. RFI activities were designed to collect sufficient information regarding the nature of environmental conditions at Exum to develop a prioritized approach for addressing corrective action needs. Implementation of the prioritized approach resulted in one of the following corrective action decisions for each area within Exum:

- No Further Action;
- Additional Data Collection and/or Risk Evaluation Needed; or
- Corrective Measures Study (CMS) or CMIP.

Consistent with the *Exum RFI Work Plan* (URS, 2011), the following human-health exposure scenarios were evaluated:

- **Industrial Worker** - Potential exposure pathways include incidental ingestion and dermal contact with surface soil (0-1 ft), and inhalation of surface soil-derived particulates and vapors. There are no buildings currently associated with Exum, nor is construction of buildings anticipated in the future. Therefore, indoor air (vapor intrusion) is considered an incomplete pathway.
- **On-Site Construction Worker** - Construction workers may potentially be exposed to chemicals in surface and subsurface soils during excavation activities. Subsurface soil depths are assumed to be 1 to 15 ft below ground surface (bgs) based on past and anticipated future industrial activities. Potentially complete exposure pathways include incidental ingestion and dermal contact with surface and subsurface soils, and inhalation of soil-derived particulates and vapors. Dermal exposure to chemicals present in groundwater is considered incomplete, as no construction is anticipated to occur below the groundwater table.
- **On-Site Maintenance/Utility Worker** - A maintenance/utility worker may potentially be exposed to chemicals in surface and subsurface soils during the installation and repair of subsurface utility lines. Subsurface soil depths are identified as 1 to 15 ft bgs based on current and anticipated future site use. Exposure pathways evaluated include incidental ingestion and dermal contact with soils, and inhalation of soil-derived particulates and vapors. Dermal exposure to chemicals present in groundwater is considered incomplete, as utilities will not be installed below the groundwater table.
- **Recreational User (Camp Branch only)** - A recreational user was identified as a potential receptor associated with Camp Branch outside the Exum security fence. Due to seasonal variations in flows, during certain times of the year, it is possible that portions of Camp Branch may be accessible to a recreational user. Therefore, a recreational user is considered a potential receptor in shallow areas of Camp Branch. Camp Branch is too small to support a fishery. The recreational user is assumed to be a wader exposed via dermal contact to sediments and surface water. Incidental ingestion of surface water is considered an incomplete pathway because waters are too shallow to support swimming.

As presented in the ADEM-approved Exum RFI Work Plan, U. S. Steel developed a Conceptual Site Model (CSM) to evaluate potential human health exposures present at Exum. For a pathway to be complete, the following conditions must exist (U.S. EPA, 1989):

- A source and mechanism of chemical release to the environment;
- An environmental transport medium (e.g., air, water, soil);
- A point of potential receptor contact with the medium; and
- A human exposure route at the contact point (e.g., inhalation, ingestion, dermal contact).

The CSM identifies potential sources of chemicals, potential environmental release mechanisms, exposure pathways, exposure routes, and human receptors specific to the site. Human health and ecological CSMs for Exum are presented in **Figures 2-1, 2-2** and **2-3** and are considered to be representative of both current and future conditions at Exum. Potential exposure pathways have been identified as potentially complete or incomplete. Pathways considered potentially complete were examined further as part of the tiered risk evaluation process.

A trespasser was also considered a potential receptor in the Exum Phase I RFI Work Plan. However, ARBCA Guidance indicates that "the trespasser scenario may not need to be evaluated if a site has a security fence surrounding all of the contaminated property in addition to security personnel on-site on a daily basis." Because each of these security conditions exist at Exum, exposures to the trespasser are considered incomplete, and an on-site trespasser scenario was not evaluated during the Phase I or Phase II RFIs. However, to address whether security procedures are warranted in the future, the trespasser scenario was further evaluated in this CMIP. Detailed results are presented in Appendix C and summarized in **Section 2.1**.

Results of the risk evaluations were compared to a target non-carcinogenic hazard index (HI) of one and the USEPA target carcinogenic risk range of 1E-04 to 1E-06. Because Exum was originally identified in the ADEM-approved Fairfield Works Phase I RFI Work Plan (URS 2002), the U.S. EPA target risk range was considered applicable for human health risk evaluation for industrial properties. The ADEM target carcinogenic risk of 1E-05 was also considered for the human health risk evaluation as stated in the Exum Phase II RFI Report.

Similar to the human health risk evaluation, a tiered approach was used in the ecological risk evaluation. A tiered approach is an iterative process used to characterize potential ecological risks and to evaluate whether chemicals are present in environmental media at levels that may pose an unacceptable risk to site-specific ecological receptors. Each tier is differentiated by the degree of sophistication, level of detail, and the amount of site-specific information used in the evaluation. Generally, a three-tiered system is used consisting of a screening level risk evaluation (Tier 1), a quantitative baseline risk evaluation (Tier 2), and a detailed or refined risk evaluation (Tier 3).

Risk management goals for the facility established that the focus for the evaluation of ecological risk is on transient wildlife species or higher trophic level organisms from surrounding communities that may periodically access the on-site areas. Transient terrestrial receptors may forage in vegetated areas around the periphery of the Upper and Lower Pads, the vegetated areas of the Upper and Lower Impoundments and around the BF/QBOP Sludge Disposal Area. These combined areas were referred to as ecological "Terrestrial Areas", and represented a single on-site terrestrial exposure unit. In addition, transient aquatic receptors may forage in the Upper Impoundment and the retention basin associated with the BF/QBOP Sludge Disposal Area. These areas were collectively referred to as the on-site "Aquatic Areas".

Camp Branch, which lies outside of the Exum boundary, is a stream/wetland complex that represents an aquatic habitat that may receive, or has received in the past, runoff from Exum. Based on ecological reconnaissance, it was concluded that Camp Branch represents a relevant aquatic food web supported by the stream/wetland complex. Therefore, the risk management goal for Camp Branch is to prevent adverse risk from exposure to Exum-related constituents transported to this ecosystem.

Ecological receptors of interest in the Terrestrial Areas of Exum were considered to be transient animals that may occasionally forage in the vegetated areas. Representative receptors selected for the terrestrial habitat were the white-tailed deer and mourning dove (herbivores); little brown bat and American robin (invertivores); and red fox and red-tailed hawk (carnivores). In the on-site Aquatic Area, representative receptors were higher trophic-level birds and mammals that may occasionally visit the impoundments and feed on aquatic organisms which may have bioaccumulated chemicals from the sediment and surface water. These were represented by the mallard, belted kingfisher, little brown bat and mink.

Representative receptors selected for Camp Branch were the benthic macroinvertebrate community, fish community, mallard, belted kingfisher, little brown bat and mink.

2.1 Human Health Risk Evaluation Results

Human health risk evaluation results as presented in the Exum Phase 2 (Revision 2) RFI Report (AECOM 2019b) are summarized in the following sections. As noted previously, results for a trespasser were also evaluated as part of this CMIP and are included below. Detailed results for the trespasser and are presented in **Appendix C**.

2.1.1 Upper Pad

Cumulative cancer risks (CR) and HI's for the Upper Pad are summarized in the following table:

Human Health Risk Evaluation Results – Upper Pad		
Receptor	**HI**	**CR**
Industrial Worker	0.4	2E-05
Construction Worker	1	2E-06
Maintenance/Utility Worker	1	5E-05
Trespasser	0.1	1E-05

Potential cancer risks for industrial and maintenance workers slightly exceed ADEM's target risk level of 1E-05; however, cancer risks are within the risk range of 1E-4 to 1E-6 for all receptor populations. HI's are equal to or less than 1 for all receptor populations.

2.1.2 Lower Pad

Risk results for the Lower Pad are summarized in the following table:

Human Health Risk Evaluation Results – Upper Pad		
Receptor	**HI**	**CR**
Industrial Worker	0.6	6E-06
Construction Worker	0.9	4E-07
Maintenance/Utility Worker	0.9	1E-05
Trespasser	0.2	1E-06

Cumulative cancer risks are all within or below the USEPA risk range of 1E-4 to 1E-6, and equal to or below ADEM's target risk of 1E-05. HI's are less than 1 for all receptor populations.

2.1.3 Upper Impoundment

Risk results for the Upper Impoundment are summarized in the following table:

Human Health Risk Evaluation Results – Upper Impoundment		
Receptor	**HI**	**CR**
Industrial Worker	7	4E-03
Construction Worker	6	1E-04
Maintenance/Utility Worker	6	3E-03
Trespasser	2	7E-04

Cancer risks for the industrial worker, maintenance/utility worker and trespasser exceeded USEPA's risk range of 1E-4 to 1E-6, as well as ADEM's target risk of 1E-05. HIs for all receptor groups were greater than 1.

2.1.4 Lower Impoundment

Risk results for the Lower Impoundment are summarized in the following table:

Human Health Risk Evaluation Results – Lower Impoundment		
Receptor	**HI**	**CR**
Industrial Worker	0.5	2E-05
Construction Worker	1	1E-06
Maintenance/Utility Worker	1	4E-05
Trespasser	0.1	3E-06

Cancer risks for all industrial and maintenance/utility workers were within USEPA's risk range of 1E-4 to 1E-6 but exceeded ADEM's target risk of 1E-05. Cancer risks for construction workers and trespassers were within USEPA's risk range of 1E-4 to 1E-6 and below ADEM's target risk of 1E-05. Noncancer hazards for all receptor groups were equal to or less than 1.

2.1.5 BF/QBOP Sludge Disposal Area

Risk results for the BF/QBOP Sludge Disposal Area are summarized in the following table:

Human Health Risk Evaluation Results – BF/QBOP Sludge Disposal Area		
Receptor	**HI**	**CR**
Industrial Worker	0.4	6E-07
Construction Worker	0.6	3E-08
Maintenance/Utility Worker	0.6	6E-07
Trespasser	0.1	2E-08

Cancer risks are below the USEPA risk range of 1E-04 to 1E-06 and ADEM's target risk of 1E-05. The HI is less than 1 for all receptor populations.

2.1.6 Camp Branch

Human health risk results for Camp Branch are summarized in the following table:

Human Health Risk Evaluation Results – Camp Branch		
Receptor	**HI**	**CR**
Recreational User	0.03	2E-06

The only relevant exposure scenario for Camp Branch was calculated for a recreational user potentially exposed to sediment and surface water. The cancer risk is within the risk range of 1E-04 to 1E-06 and below ADEMs target risk of 1E-05. The HI was less than 1.0.

2.1.7 Evaluation of Groundwater

Groundwater beneath and in the vicinity of Exum is not currently used as a source of drinking water nor is it planned for use as a source for drinking water in the future. Furthermore, there are no active drinking water supply wells within one mile of the Fairfield facility (URS, 2005). Groundwater could contribute to vapor intrusion into buildings if volatile organic compounds (VOCs) are present. There are no buildings currently associated with Exum, nor is construction of buildings anticipated in the future. Therefore, indoor air (vapor intrusion) is considered an incomplete pathway. Outdoor inhalation of vapor emissions from groundwater is considered to be a potentially complete but insignificant pathway due to rapid dissipation of any potential

vapors in outdoor air. Based on this information, the groundwater exposure pathway is considered incomplete as approved in the Exum Phase I RFI Report.

Although the drinking water pathway is considered incomplete for both current and future uses, ADEM requires that the risk evaluation address groundwater as a potential future drinking water source. As reported in the ADEM approved Exum Phase I RFI Addendum Groundwater Investigation Report (URS, 2013), results of the human health risk evaluation indicated a noncarcinogenic HI of less than 1. Therefore, it was concluded that groundwater at Exum does not pose unacceptable noncarcinogenic hazards. Carcinogenic risks exceeded the ADEM target risk level of 1E-05 in Lower Pad monitoring wells MW-3A and MW-6 and Upper Pad monitoring wells MW-9 and MW-10 (URS, 2013).

There is the potential that groundwater could migrate to surface waters of Camp Branch. Camp Branch and the associated wetland complex form the western boundary of the Lower Pad. Surface water runoff from the Upper and Lower Pads also discharge into Camp Branch. Potential impacts to surface waters of Camp Branch were evaluated in the Exum Phase I RFI report and human health and ecological risk evaluations were completed. Results of the human health risk evaluation indicated no unacceptable human health or ecological risks are associated with Camp Branch. Risks to ecological receptors were considered low.

The soil-to-groundwater pathway was also evaluated as part of the Phase II RFI (U. S. Steel, 2019b). Potential migration of chemicals from soil to groundwater was evaluated using synthetic precipitation leaching potential (SPLP) data. The intent of the SPLP analyses was to provide a site-specific measure of the potential for chemicals present in soils to leach and impact groundwater as a result of infiltrating precipitation. SPLP results indicated that several semi-volatile organic compounds (SVOCs) and metals constituents have the potential to leach from soils at concentrations exceeding groundwater screening levels.

To further evaluate the soil to groundwater pathway, groundwater samples were collected from existing and new monitoring wells during the Exum Phase II RFI. With the exception of arsenic, none of the constituents driving carcinogenic risks during the Exum Phase I RFI were detected in groundwater samples collected from existing and new monitoring wells in 2017 during the Exum Phase II RFI. Of the SVOCs detected in the SPLP samples at concentrations exceeding screening levels, only acenaphthene, fluorene, n-nitrosodi-n-propylamine, and pyrene were detected in groundwater samples collected from the Upper and Lower Pads. Metals constituent concentrations detected in SPLP samples observed in groundwater samples collected from the Upper and Lower Pad monitoring wells were consistent with background concentrations and were considered naturally occurring.

ADEM requested that further evaluation of the SPLP results for organics be considered relative to potential migration to groundwater at the Exum boundary. Consistent with ADEM guidance (ADEM, 2017), this was conducted using the Domenico model for multi-dimensional transport with decay and continuous source. The constant-strength source was assumed to be the SPLP concentrations exceeding groundwater screening criteria. Results indicated that constituent concentrations were all reduced to below their respective screening levels within 250 ft from the source area. It was concluded that the soil-to-groundwater pathway would not result in exceedances of groundwater screening criteria at the property boundary.

Per Permit Condition III.B.4.c, U. S. Steel will collect post closure groundwater samples subsequent to successful implementation of corrective action activities. Groundwater samples will be collected from the existing Exum well network monitoring wells MW-10 (Upgradient) and MW-15, MW-6 and MW-17 (Downgradient). Upgradient and downgradient monitoring well locations were identified based on results of historical groundwater monitoring activities.

2.1.8 Human Health Risk Evaluation Summary and Recommendations

The following recommendations for each Exum investigation area were made in the ADEM-approved Phase II RFI report based on the findings of the human health risk assessments:

SWMU	Description	Recommendations
SWMU 23 – Exum Materials Management Area	Upper Pad	CMIP (Environmental Covenant/Land Use Controls [LUCs]) including the Pipe Mill Varnish Area
	Upper and Lower Impoundments	CMIP (Environmental Covenant /LUCs) for Lower Impoundment. Additional land use restrictions or other alternative corrective/remedial actions to reduce the overall exposure associated with the Upper Impoundment may be required.
	Lower Pad	CMIP (Environmental Covenant /LUCs)
	BF/QBOP Sludge Disposal Area	CMIP (Environmental Covenant /LUCs)
	Camp Branch	No Further Action
	Groundwater	CMIP (Environmental Covenant /LUCs)

Note the Phase II RFI report recommended Environmental Covenant/LUCs for Camp Branch. However, No Further Action is necessary because there were no unacceptable risks identified for either human or ecological receptors, and potential future use of Camp Branch for residential purposes is not applicable to a creek environment. Therefore, no further action is recommended in this CMIP.

2.2 Ecological Risk Evaluation Results

2.2.1 On-Site Terrestrial Areas

For the terrestrial non-operational portion of Exum, upper-bound hazard quotients (HQs) were generally less than 3 for herbivorous birds and mammals (mourning dove and white-tailed deer) and were less than 1 for carnivores (red-tailed hawk and red fox). Upper-bound HQs were generally less than 5 for invertivores (woodcock and little brown bat). Exceptions to this were chromium, nickel and HMW PAHs, which had upper-bound HQs of 21, 8 and 7, respectively, for the woodcock. In addition, the upper-bound HQ was 14 (high molecular weight polynuclear aromatic hydrocarbons [HMW PAHs]) for the little brown bat.

Elevated exposure concentrations were largely influenced by the greater number of samples within soils surrounding the Upper Impoundment, although this area was only a small component of the overall foraging area within the terrestrial exposure unit evaluated. Estimates of metals and PAHs in invertebrate tissue also were unrealistically high, which resulted in unrealistically elevated HQs. Soil invertebrates, which comprised the largest contribution to dose for the woodcock and little brown bat, are unlikely to thrive and reproduce in soil with elevated metals and PAHs, and which is comprised largely of slag.

While locally elevated concentrations of chemicals of potential ecological concern may be present, these areas are unlikely to have a substantive influence when considering the overall site and foraging habits of transient receptors.

2.2.2 On-Site Aquatic Areas

Representative receptors in the on-site aquatic areas included the mallard, belted kingfisher, little brown bat and mink. All upper-bound HQs were less than one for the mallard, little brown bat and mink. For the kingfisher, the upper-bound HQ exceeded 1 only for mercury (7); the lower-bound HQs were greater than one for HMW PAHs (2), and lead (2). It is noted that the exposure model assumes a resident kingfisher rather than a transient visitor. Thus, risks to transient receptors from exposure to COPECs in the on-site water bodies are expected to be lower than estimated.

2.2.3 Camp Branch

Camp Branch represents a wetland/creek area located adjacent to, but outside the Exum boundaries. In Camp Branch, the ecological risk assessment evaluated benthic biota, fish, and birds and mammals exposed to constituents of concern in sediments and surface water. For benthic biota in sediments, upper-bound HQs exceeded one only for lead (1.2) and zinc (3). Although these may suggest a slight suppression of the benthic community, risks are considered low. No HQs above one were

identified for fish in surface water, or for birds and mammals exposed to surface water or sediments. Overall, risks to ecological receptors in Camp Branch are considered low.

2.2.4 Ecological Risk Evaluation Summary and Recommendations

As noted previously, potential risks to ecological receptors associated with Camp Branch are considered low. In the on-site portions of Exum, HQs exceeding one were primarily associated with invertivorous birds and mammals. The quality of the habitat is considered marginal. The area does not provide a preferred foraging area, and the forage itself will be limited due to both habitat and physical/chemical limitations. Based on the conservatism in the risk estimates, the uncertainties which will generally result in an overestimate of risk, and the general poor quality of the habitat, ecological risks within the Exum boundaries are considered low for transient birds and mammals. No corrective actions at Exum are recommended for ecological receptors.

3 Corrective Action Objectives

The corrective action objectives for Exum are as follows:

- Be protective of human health and environment;
- Meet cumulative risk-based performance standards; and,
- Control the source of potential releases.

The preferred corrective action for Exum to address elevated constituent concentrations in the Upper Impoundment is to cover in place with an appropriate slag cover. Surficial material located in the Upper Impoundment will be mixed with soil and slag, if needed prior to constructing the cover. Land use controls administered through an environmental covenant for the entirety of Exum will also provide additional controls to mitigate soil exposures as well as prohibit groundwater use. The corrective measure meets the stated objectives by eliminating direct contact with the impacted soils thereby reducing overall risks to acceptable performance standards.

3.1 Land Use Controls/Environmental Covenant

A draft environmental covenant has been developed in accordance with the Uniform Environmental Covenants Program (UECP), ADEM Administrative Code 335-5, effective October 4, 2019. The intent of the environmental covenant is to reduce potential risks to human health and/or environment by restricting activity and land use at Exum. Environmental Covenants administered through ADEM pertain to sites where impacted media (e.g., soil) remain in place at concentrations prohibiting unrestricted use (i.e., would prohibit residential use).

As stated in the UECP, an environmental covenant may be applied to a property or properties in lieu of remediating the property to an acceptable level that allows for unrestricted use. Because Exum has been used for industrial purposes since its founding and will remain as an industrial property for the foreseeable future, remediating the property to a level that would allow unrestricted use is not practical or necessary. Therefore, land use controls through an environmental covenant is the most effective and logical approach to protecting human health and the environment.

Land use controls and the environmental covenant developed for Fairfield Works will also be applicable to Exum. Consistent with UECP requirements, chemicals of interest (COIs), legal description and land use controls are included in the environmental covenant as discussed in the following sections. The draft environmental covenant for Exum is included as **Appendix A**.

3.2 Corrective Action Area

Relevant human receptors and risk evaluation results for Exum were summarized in **Section 2**. Preliminary corrective actions were identified by eliminating soil boring locations with elevated risks or hazards from the Upper Impoundment risk evaluation data set (simulating a corrective action), with the objective of reducing the cumulative risks and hazards for the Upper Impoundment to acceptable levels. The sample locations and associated footprint encompassed in the proposed corrective action area is shown in **Figure 3-1**. Prospective post-corrective action risk estimate calculations are presented in **Appendix B**. Assuming the proposed area is addressed through corrective measures, prospective post-remediation cumulative hazards and risks were estimated for the Upper Impoundment to assess whether projected risk levels would be reduced to acceptable levels. The findings of the cumulative risk evaluation for the commercial/industrial worker, construction worker, maintenance/utility worker and trespasser excluding the area currently identified in **Figure 3-1** are as follows:

Receptor	HI	CR
Commercial/Industrial Worker	1	9E-05
Construction Worker	2	3E-06
Maintenance/Utility Worker	2	8E-05
Trespasser	0.3	1E-05

Considering the removal[1] of soil in the corrective action areas, the cumulative carcinogenic risk for each receptor remains within the U.S. EPA's target range of 1E-04 to 1E-06. The cumulative carcinogenic risk for the commercial/industrial worker (9E-05) and maintenance/utility worker (8E-05) in the Upper Impoundment exceed the ADEM target carcinogenic risk of 1E-05. In addition, the HI for the construction worker and maintenance/utility worker is 2, which exceeds the U.S. EPA and ADEM target HI of 1. It should be noted that arsenic concentrations detected at Exum, which are influenced by elevated background arsenic levels as presented in the Phase I RFI Report (URS, 2005), also contributed to the cumulative carcinogenic risk, and arsenic, iron and manganese contribute substantially to the HI as well. Based on the results of the prospective post-corrective action cumulative risk evaluation, it is proposed that addressing the corrective action area noted above, and with the application of administrative and engineering controls, will reduce potential risks and hazards to acceptable levels in the Upper Impoundment at Exum.

In addition to limiting future land use to a commercial/industrial worker, additional land use controls may include excavation permits, soil management plans and additional administrative controls to mitigate the potential for exposures to impacted soils within the corrective action area and will further reduce cumulative risks.

[1] "Removal" in this context is intended to indicate control of exposures and does not necessarily indicate physical removal.

4 Corrective Action Conceptual Design

This CMIP addresses the corrective measures to be implemented within the Upper Impoundment as shown on **Figure 3-1**. Based on the calculated values from the post-remediation cumulative risk evaluation, implementing corrective measures to address impacted soils would reduce cumulative risks and hazards to acceptable levels for the Upper Impoundment. Prior to implementing corrective measures, additional data collection will be used to provide necessary information for completing the design.

The following are the key site/risk conditions that were considered when developing corrective measures for the Upper Impoundment:

- The site and surrounding properties are currently owned by U. S. Steel and have been used for industrial purposes (steel production) since 1912. It is unreasonable to expect any future land use beyond commercial/industrial purposes. In addition, land use controls through application of an environmental covenant for Exum is proposed that will restrict future land use to industrial only. The Exum site is currently managed under RCRA Post-Closure Permit ALD 002 904 506.
- The calculated cumulative risk assessment of the Upper Impoundment resulted in an unacceptable risk (cancer risk greater than 1E-04 and HI greater than 1) based on soil exposures to commercial/industrial, construction and maintenance/utility workers. There are no additional activities besides implementation of the corrective measures planned in the Upper Impoundment area. In addition, land use controls such as excavation permits and other administrative controls will further reduce the potential for direct contact with impacted soils in the corrective action area.
- The impacted area is well within the boundary of the U. S. Steel facility, which is surrounded by a secure chain-link fence with automated access gates.
- There are no complete exposure pathways to groundwater beneath Exum. In addition, land use controls through application of an environmental covenant for Exum are proposed that will prohibit groundwater use for irrigation or potable use. Therefore, soil corrective measures proposed for the corrective action areas are not intended for the protection of groundwater, but rather to mitigate direct exposure to surface and subsurface soils.
- In the event waste characterization samples collected from soils indicate the disturbed material is classified as hazardous waste, U.S. EPA's "Area of Contamination (AOC) Policy" -would be applicable for managing the material. The AOC policy allows for certain discrete areas of generally dispersed contamination of hazardous waste to be considered RCRA units. Because an AOC is equal to a RCRA unit, consolidation and in-situ treatment does not create a new point of generation and therefore does not trigger land disposal restrictions or minimum technology requirements.

The proposed corrective measure (Final Remedy) identified for the Upper Impoundment is discussed in the following sections.

4.1 Proposed Corrective Measure

For the Upper Impoundment, the proposed corrective measure is to construct a protective cover over the impacted soils to eliminate direct contact. The proposed cover will consist of 2 feet of slag. Slag was identified as the preferred cover media because it is a readily available inert material that when placed over the impacted area will remain intact and provide a permanent barrier to direct contact. As compared to a soil cover, it is less susceptible to erosion, and it will not be compromised by encroachment of vegetation or burrowing animals and therefore requires minimal maintenance. In addition, using the slag as cover material provides a beneficial use for a material that is readily available and has already been used extensively as a backfill and cover in other areas of the Fairfield facility. A depth of 2 feet of slag is more than sufficient to provide complete coverage as a permanent barrier.

4.2 Corrective Measures Implementation

Corrective measures implementation (CMI) will consist of the following:

- Remedial design/Data collection;
- Permitting and regulatory approvals;
- If needed, mixing and consolidating soils in the Upper Impoundment;
- Constructing the slag cover systems over soils in the Upper Impoundment;
- Institutional controls; and
- Post-closure monitoring and maintenance.

The above activities are discussed in greater detail in the following sections.

4.3 Remedial Design/Data Collection

Prior to cover construction, data collection to support the corrective action design will be conducted. Samples will be collected from sediments within the pond and from soils to be mixed within the berm areas if needed.

Using GPS coordinates recorded during previous delineation activities, an Alabama licensed professional land surveyor will locate the original boring locations as well as establish the impacted soil limits for the Upper Impoundment. In addition, the topography of the Upper Impoundment will be surveyed for use during the corrective action design to facilitate proper drainage from the covered area. The physical boundaries of the Upper Impoundment will also be surveyed. Soil and cover volumes will be estimated based on the survey data. Once construction is complete, a post-construction survey will be completed to confirm the cover thickness and extent in the Upper Impoundment.

4.4 Permitting and Regulatory Approval

The following summarizes the regulatory and permitting requirements for implementation of the corrective measure.

4.4.1 Permit Modification

Pursuant to Permit Condition IV.E.3, a permit modification request was previously submitted to ADEM in conjunction with the Fairfield Works CMIP dated November 27, 2017. This permit modification included Exum. It was acknowledged in the Fairfield Works CMIP that investigation activities were still ongoing at Exum. The Fairfield Works CMIP was approved with the permit renewal, effective September 17, 2019. The Exum CMIP will require a separate major modification.

4.4.2 ADEM Stormwater General Permit

The proposed construction activities for the Upper Impoundment corrective measures will disturb an area greater than 1.0 acre. U. S. Steel will prepare a Construction Best Management Practices Plan (CBMPP). The CBMPP must be prepared by a qualified professional (QCP) to minimize pollutant discharges in stormwater runoff to the maximum extent practicable during land disturbance activities. A CBMPP will be prepared for the Site work and submitted to ADEM with the request for registration.

4.4.3 Wetland Delineation

It will be determined if wetlands are present or if a delineation needs to be completed during the corrective action design. If jurisdictional wetlands are present, U. S. Steel will submit a completed United States Army Corps of Engineers (USACE) Nationwide Permit 38 (NWP 38) which allows for the cleanup of hazardous and toxic waste that are performed, ordered, or sponsored by a legal or regulatory authority. If jurisdictional wetlands are present, it is expected that corrective action activities would be authorized by NWP 38.

4.4.4 Air Permitting

It is expected that implementation of corrective measures will not require an air permit. Placement of slag material and general site activities associated with implementing the corrective measures can cause nuisance dust consistent with general Fairfield Works site activities. Water will be used routinely as a dust suppressant. Water will be applied along haul roads and in the work areas as necessary to control dusty conditions using mobile water/spray trucks. Upon approval of this CMIP, U. S. Steel will confirm air permit requirements.

4.5 Cover System General Construction

The general procedures for construction of a slag cover system will be as follows:

- Remedial design investigation to define the volume of soils to be included;
- Site preparation and grading; and
- Construction of a slag cover system.

These activities are described in more detail in the following sections.

4.5.1 Site Preparation and Grading

Areas within the Upper Impoundment will be cleared to provide access to the pond area. Clearing will consist of cutting trees and other vegetation to the ground surface and either leaving the roots in place or grubbing depending on the size of the roots and whether they are located within the impacted area. The trees and/or vegetation that are removed will be managed onsite, either chipped or ground down. A construction road will be completed to access the impacted soil and pond areas. The lines and grade elevations will be determined in the design phase based on the topography/elevation survey to facilitate drainage from the covered area(s).

4.5.2 Slag Cover Construction

The cover will consist of 2 feet of slag that is available from Fritz Enterprises (Fritz). Fritz manages slag previously produced at the U. S. Steel facility during iron production. The Fritz facility is located on U. S. Steel-owned property adjacent to the Fairfield Works facility. Fritz sorts, screens, and pulverizes slag previously produced at Fairfield Works to various grades for commercial and industrial applications. Prior to placing and compacting the material, geotechnical tests will be performed on the slag to determine the appropriate placement method in order to minimize erosion and provide permanence.

These tests may include the following:

- Laboratory Determination of Water (Moisture) Content of Rock and Soil Aggregate Mixtures (ASTM D2216);
- Soil Classification (D2487);
- Amount of Material in Soils Finer than the No. 200 Sieve (D1140);
- Liquid Limit (Minimum) (D4318);
- Plasticity Index of Soil (D4318);
- Moisture Density Relationships of soils and Soil Aggregate Mixtures Using 5.5-lb Hammer and 12-inch Drop (Standard Proctor) (D698); and
- U.S. Sieve Analysis (C136)

Impacted soil from the Upper Impoundment may be placed and mixed with in-situ sediments from the pond. Data from the topographic survey will be used to calculate soil volumes and dimensions of the area(s) to be covered.

Prior to placing the slag, a non-woven geotextile will be placed over the area for separation. The slag will be placed in lifts and spread and compacted to minimize erosion using placement methods determined from the geotechnical testing. **Figure 4-1** shows the estimated soil cover areas. A typical detail of the cover is shown on **Figure 4-2**. The lines and grades will be determined in the detailed design documents to be developed upon approval of this CMIP and prior to implementation. Topographic surveys will be performed to verify lines, grades, and slag thickness during construction.

4.6 Consolidating, Mixing and Covering the Upper Impoundment

The general sequence of the work for consolidating, mixing and covering soils within the Upper Impoundment will include the following:

- Treatability testing;
- Consolidating soil from the impacted areas of the Upper Impoundment into the pond;
- Mixing impacted soil with existing surficial sediment within the Upper Impoundment; and
- Constructing the cover system.

Figure 4-2 provides a typical cross-section of the Upper Impoundment soil cover.

4.6.1 Treatability Testing

Treatability testing procedures will be prepared to evaluate whether materials need to be mixed. The evaluation will include items such as consistency, ability to drain and strength after mixing. Soil, sediment and slag collected during the remedial data collection activities will be tested for physical soil characteristics and each type of material will be mixed together at various percentages and sediments will be evaluated for drainage characteristics. The results will be used to prepare the remedial design.

4.6.2 Consolidating and Mixing Upper Impoundment Soils

The remedial design will determine the volume and limits of impacted soil from the Upper Impoundment to be consolidated and mixed within the pond area. The soils will be mixed with the existing material within the pond. Slag may be added if needed to further consolidate the mixed materials. The consolidated material will be required to support the construction of the cover system and the cover system over the long-term. This typically requires a target strength of about 10 to 12 psi. The strength can be tested in the field using a pocket penetrometer. If field measurements indicate that the consolidated soils are not strong enough to support construction of the cover system a geogrid can be used to provide support to the cover system. The volume of impacted soil, slag, and/or sediment recommended to form a sufficiently strong base to support a slag cover over the Upper Impoundment will be evaluated during the remedial design investigation. Additionally, the depth of soil to be excavated, graded and the final target elevation of the site will be determined during the remedial design to limit erosion and manage stormwater.

4.6.3 Cover Construction

The cover components will consist of the following layers from the consolidated surface to the top:

- A geotextile separation layer; and,
- A 2-feet compacted slag layer.

A non-woven geotextile will be placed on top of the consolidated surface to provide separation from the constructed cover. A 2-feet compacted slag layer will then be constructed on top of the geotextile to provide a permanent barrier system. The slag cover will be compacted in minimum 6–inch loose lifts.

Slag will be placed and graded over low areas resulting from removal or excavation of impacted material being consolidated and mixed in the pond area. The slag will be graded to match the cover system constructed over the pond area.

The cover system may contain different gradations of slag to provide the best permanent barrier, reduce erosion and improve compaction. The slag cover system will be graded to drain following the grading plan developed in the detailed design.

4.6.4 Site Restoration

In general, site restoration activities will include removal of erosion control measures (i.e., silt fence) and regrading support areas and equipment storage areas to existing grade. Additional slag may be added to low lying areas adjacent to corrective action areas to promote positive drainage away from the corrective action areas.

4.7 Land Use Controls/Environmental Covenant

Land use controls through an environmental covenant were proposed for Fairfield Works in the Fairfield Works CMIP dated January 10, 2019. Proposed land use restrictions included the following, which are also proposed for Exum, include:

A. The development or use of the Property for residential purposes is prohibited; and,

B. The use of onsite groundwater for potable or irrigation purposes on or off the Property is prohibited.

Additional land use controls may include restrictions to site activities in the corrective action areas that could compromise the effectiveness of the cover systems, excavation permits, soil management plans for excavated material, and upgraded personal protective equipment for industrial and/or maintenance workers who may come into direct contact with impacted soils in the corrective action areas. The Environmental Covenant for Exum will be finalized after the CMI Plan is approved and the work which includes capping a portion of the Upper Impoundment is completed.

4.8 Post Closure Monitoring and Maintenance

As previously stated, slag was identified as the preferred cover media because it is a readily available inert material that when properly placed, will remain intact and provide a permanent barrier to direct contact. Slag is not generally susceptible to erosion and will not be compromised by encroachment of vegetation or by burrowing animals and therefore requires minimal maintenance. U. S. Steel proposes to inspect the slag covers in the corrective action areas on an annual basis to evaluate the continued effectiveness of the covers for their intended use. The areas will be inspected for surface erosion and settling. Visible areas of surface erosion will be repaired with additional slag material or other suitable material. Low-lying areas resulting from potential settling will also be backfilled to be consistent with surrounding grade. Vegetative infill of the covered areas is not expected although it is not uncommon to see isolated pockets of vegetative growth due to general depositional and succession activities. Unless vegetative growth is determined to present a potential problem or compromises the integrity of the cover, vegetation will be left in place where it occurs. Inspections will be completed by U. S. Steel personnel or their designates. Inspection records will be kept onsite in the Environmental Affairs office.

Per Permit Condition III.B.4.c, and ADEM Admin Code r. 335-14-5-.06, U. S. Steel will collect post closure groundwater samples for three consecutive years after corrective action has been completed. For post closure groundwater monitoring, groundwater samples will be collected from upgradient and downgradient monitoring well locations. Upgradient and downgradient monitoring well locations were identified based on results of historical groundwater monitoring activities completed at Exum. Based on the interpreted groundwater flow direction observed, the following existing monitoring wells were identified for post closure groundwater monitoring (see also **Figure 1-3**):

- Upgradient Monitoring Well MW-10
- Downgradient Monitoring Wells MW-15, MW-6, and MW-17

As stated in Permit Condition III.B.4.c, groundwater samples will be collected on an annual basis for a minimum of three years (or until groundwater protection standards have not been exceeded for a period of three consecutive years) with the initial groundwater sampling event completed 60 days subsequent to completion of the corrective measures described in Section 4.1 herein. Analytical data for each event will also be compared to background groundwater data collected for the site.

Groundwater samples will be collected using a submersible pump and low flow purge and sample techniques in general accordance with the Field Sampling Plan presented in the ADEM approved U. S. Steel Fairfield Works Phase I RFI Work Plan (URS, 2002). Groundwater samples will be analyzed for the analytical parameters identified in Table III.2, Groundwater Quality

Monitoring Constituents of the current Permit (see Table 4-1) using the most recent U.S EPA SW-846 analytical method. A letter report documenting the field activities and findings of the groundwater sampling events will be submitted to ADEM within 60 days after the sampling event is completed. After completion of the third annual post-closure groundwater sampling event, U. S. Steel will review the post-monitoring groundwater requirement with ADEM.

5 Schedule and Reporting

Upon receipt of ADEM approval, U. S. Steel will develop and implement data gathering activities as previously described, complete the design and then prepare construction plans, specifications, and begin contractor procurement. As stated in Permit Condition V.D.1, CMI Progress Reports are required for project durations that will extend greater than 180 calendar days. U. S. Steel will implement corrective measures and submit CMI Reports per a schedule agreed upon by both U. S. Steel and ADEM following approval of this CMIP and subcontractor procurement. The CMI Progress Reports will include the following updates:

- CMI construction drawings;
- CMI construction schedule; and,
- CMI general correspondence, project updates, and potential deviations.

In accordance with Permit Conditions I.G.4. and IV.E.4, U. S. Steel will update the cost estimate no later than 30 calendar days after the Department has approved a modification to the Closure Plan, Post-Closure Plan, or Corrective Action Plan, or any other plan required or referenced by this permit, if the change in the plan results in an increase in the amount of the cost estimate. Within 120 calendar days after this Permit has been modified in accordance with Permit Condition IV.E.3., U. S. Steel will submit documentation that demonstrate financial assurance for completing the approved remedy.

Pursuant to Permit Condition V.D.4, U. S. Steel will submit a Final Report of Corrective Measures (FRCM) Report upon successful implementation of the corrective measure containing, at a minimum, the following:

- A description of the activities completed;
- As-built drawings presenting the final in-place three-dimensional location of contaminated material as well as a plan view of remediated areas and cross sections of the in-place capped areas;
- Waste manifests of any materials shipped off-site to an ADEM-approved landfill;
- A copy of the Environmental Covenant required by Permit Condition V.B;
- Monitoring data (e.g., soil, air, dust, water) collected for any reason during implementation; and
- Certification statement prepared in accordance with ADEM Administrative Code Rule 335-14-8-02 (2)(d) by U. S. Steel and an independent Alabama registered engineer stating that the corrective measures are complete and ready for operation in accordance with the intended design (i.e., CMIP).

The FRCM will be submitted within 90 days following the attainment of corrective action goals as stated in this CMIP. Upon ADEM approval of the FRCM, U. S. Steel will consider the corrective measures implementation for the Upper Impoundment within Exum to be complete.

6 References

ADEM. 2008. Alabama Risk-Based Corrective Action Guidance Manual, Revision 2. April.

ADEM. 2017a. RCRA Post Closure Care Permit ALD 002 904 506. June.

ADEM. 2017b. Alabama Risk-Based Corrective Action Guidance Manual, Revision 3. June.

AECOM. 2019a. United States Steel Corporation Fairfield Works Corrective Measures Implementation Plan – Revision 1, E PA ID No. ALD 002 904 506, January.

AECOM. 2019b. United States Steel Corporation Exum Materials Management Area Phase II RFI Report (Revision 2), EPA ID No. ALD 002 904 506. February.

Fleming & Blair. 1998. Current Conditions Report. Prepared for USS Fairfield Works. July 1998.

USEPA. 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. December 1989. EPA/540/1-89/002.

USEPA. 1991. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. Interim Final. Office of Emergency and Remedial Response, Toxics Integration Branch, Washington, D.C.

USEPA. 1997. Exposure Factors Handbook. Volumes I, II, and III. Office of Research and Development. EPA/600/P-95/002Fa, b, and c.

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Office of Superfund Remediation and Technology Innovation, Washington, D.C. July 2004. EPA/540/R/99/005.

URS. 2002. Phase I RCRA Facility Work Plan – U. S. Steel Fairfield Works. Prepared for U. S. Steel Corporation, Pittsburgh, PA by URS Corporation. June 2002.

URS. 2005. Phase I RCRA Facility Investigation Report, U. S. Steel Fairfield Works, Fairfield, AL. December 21, 2005.

URS. 2011. Exum RFI Work Plan, Phase II RFI Work Plan Addendum, Exum Materials Management Area, Fairfield Works, Jefferson County, Alabama. August 18, 2011.

URS. 2012 Exum Phase I RFI Report, Exum Materials Management Area, Fairfield Works, Jefferson County, Alabama. June 20, 2012.

URS. 2013. Exum Phase I RFI Report Addendum, Groundwater Investigation, Exum Materials Management Area, Fairfield Works, Jefferson County, AL. January 18, 2013.

FIGURES

Ensley Slag Recovery Area

Exum Materials Management Area

Fairfield Works

Figure 1-1

Site Location Map

United States Steel
Exum Facility
Fairfield, Alabama

N

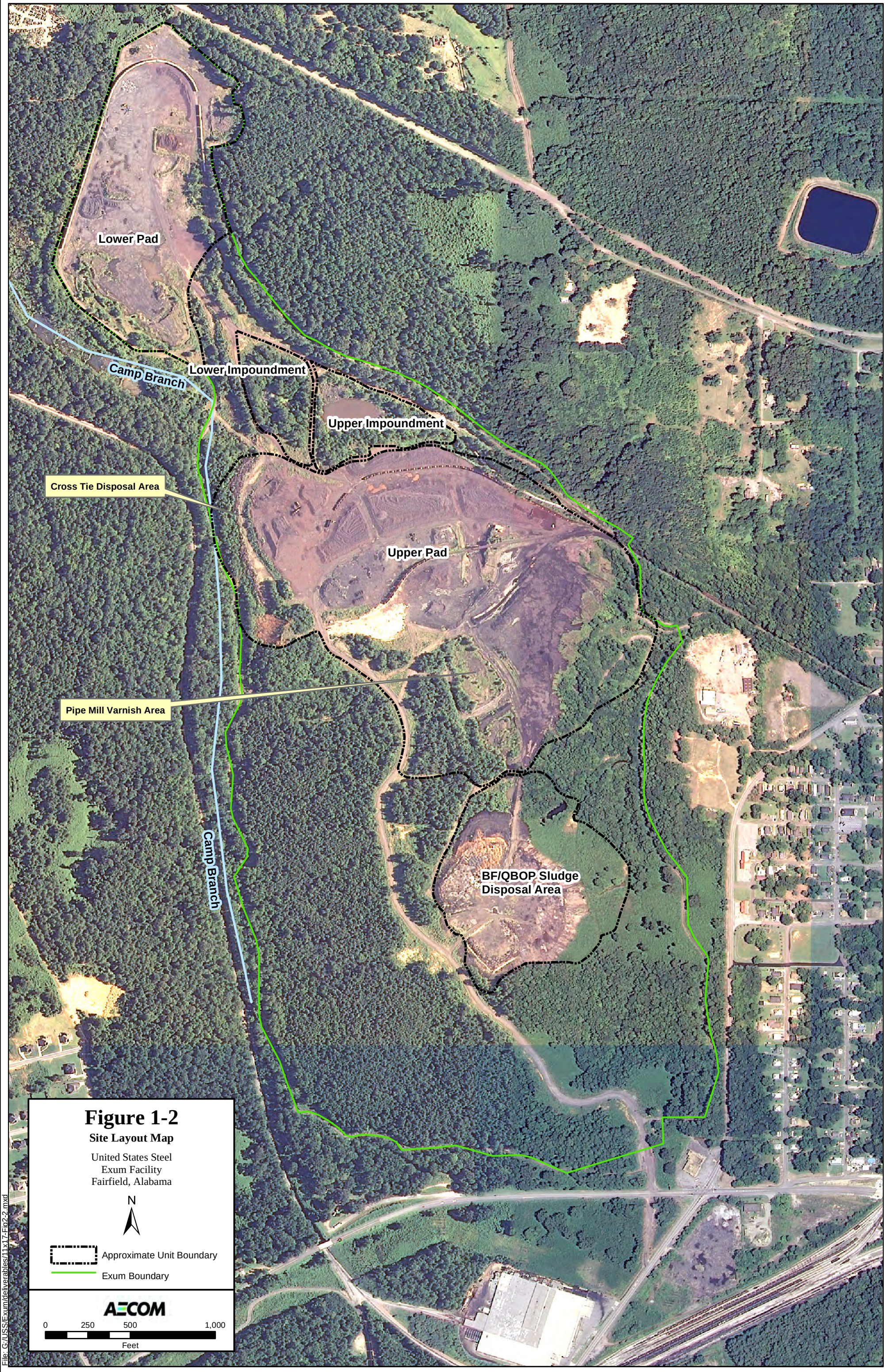
Facility Boundary

AECOM

0 0.1 0.2 0.3

Miles

File: G:/USS/Exum/deliverables/11x17-Fig2-2.mxd


Lower Pad
Camp Branch
Lower Impoundment
Upper Impoundment
Cross Tie Disposal Area
Upper Pad
Pipe Mill Varnish Area
Camp Branch
BF/QBOP Sludge
Disposal Area
Figure 1-2
Site Layout Map
United States Steel
Exum Facility
Fairfield, Alabama
N
Approximate Unit Boundary
Exum Boundary
AECOM
0
250
500
1,000
Feet
File: G:/USS/Exum/deliverables/11x17-Fig2-2.mxd

Note: Location of well MW-1 is approximate; well was not able to be located in field.

MW-1
Lower Pad
MW-17D
MW-17S
MW-6
MW-3a
MW-16
Upper Impoundment
MW-10
Camp Branch
Lower Impoundment
MW-15
MW-14
Upper Pad
MW-12
MW-11
MW-13
BF/QBOP Sludge Disposal Area
Camp Branch
MW-9

Figure 1-3

Regional Faults & Exum Monitoring Well Locations

United States Steel
Exum Facility
Fairfield, Alabama

N

- Phase II RFI Monitoring Wells
- Phase I RFI Monitoring Wells
- Existing Lower Pad Monitoring Wells
- Approximate Unit Boundary
- Exum Boundary
- Pottsville zone fault

AECOM

0 250 500 1,000
Feet

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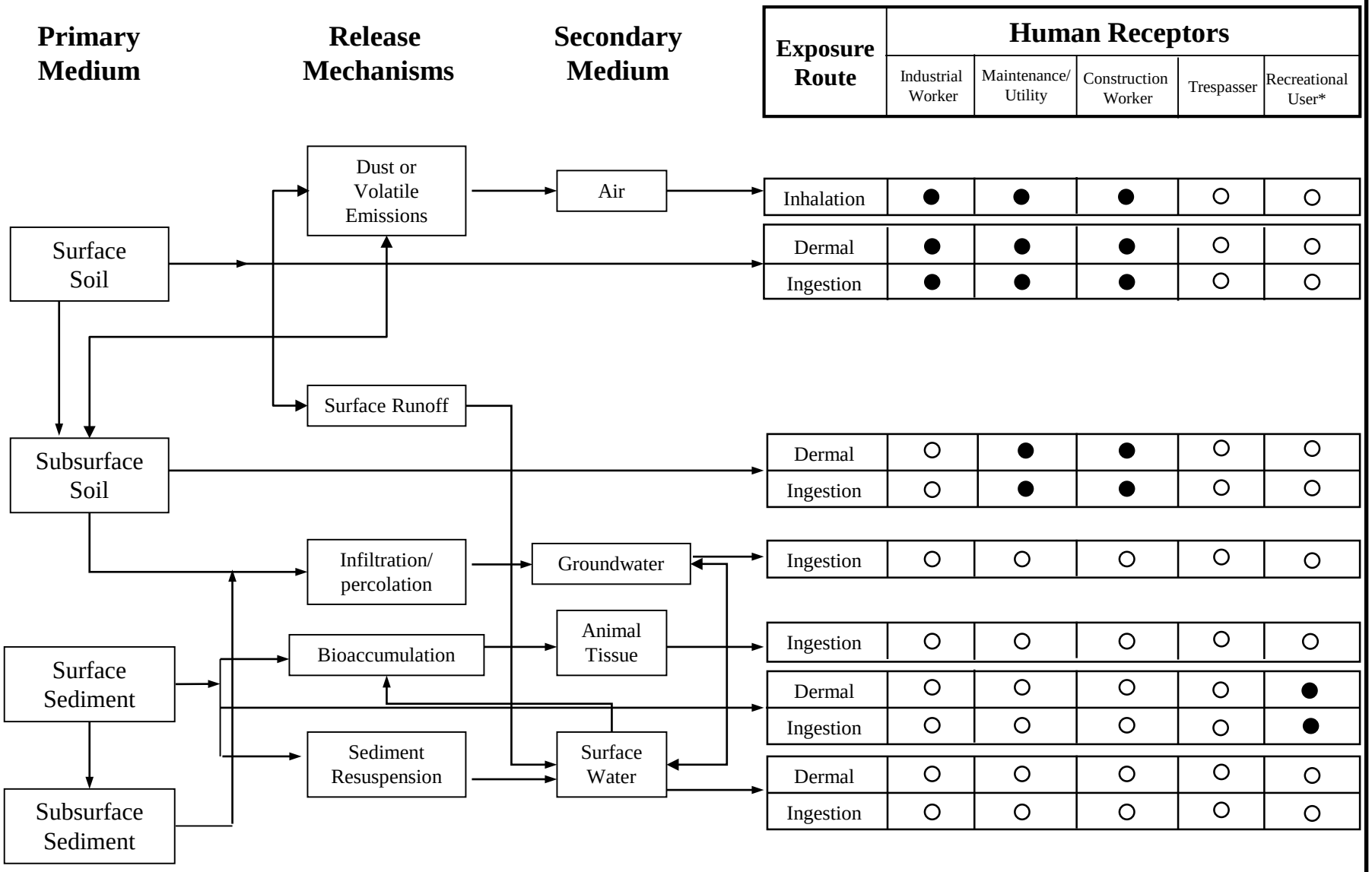
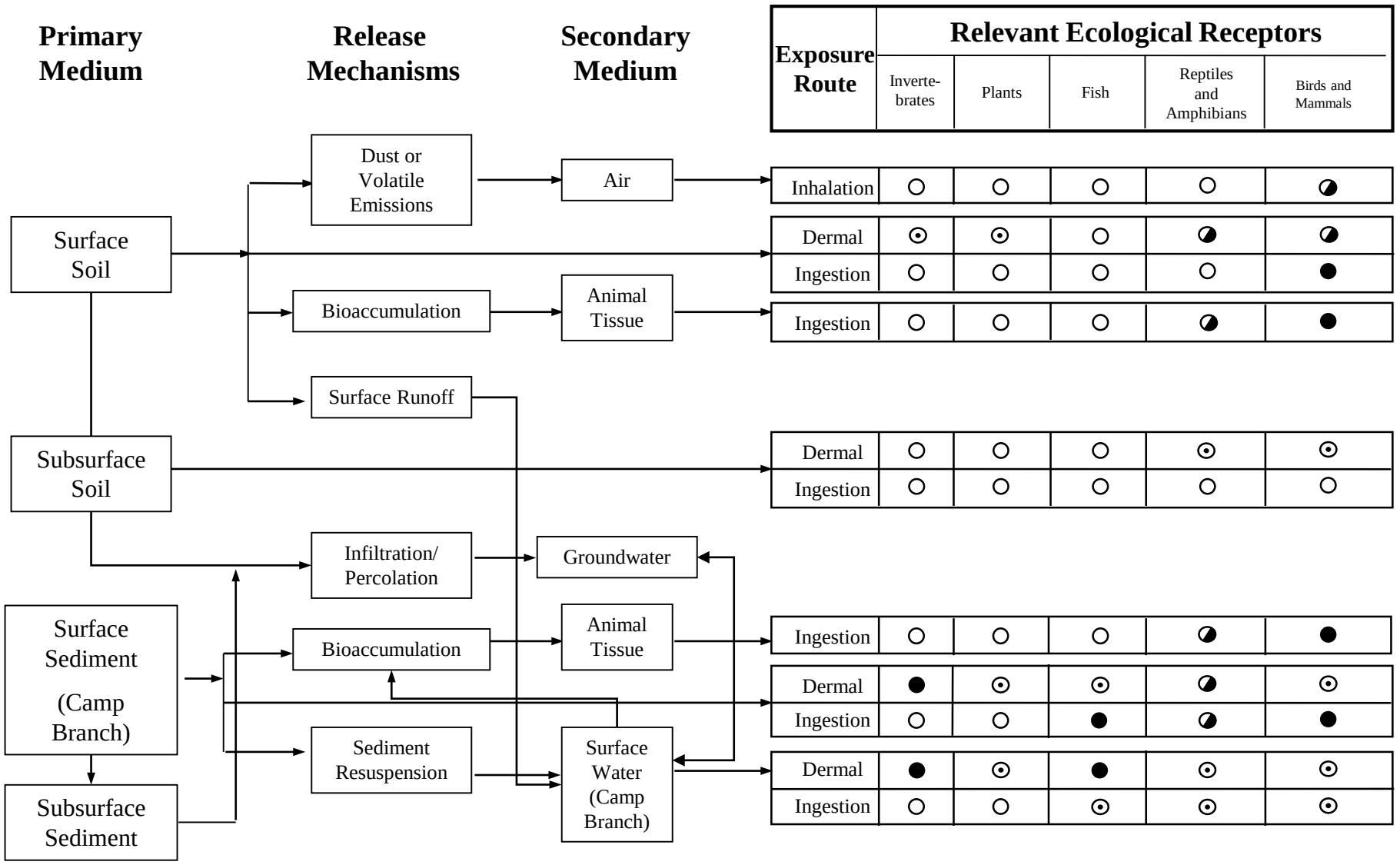


Exum Conceptual Site Model – Human Health

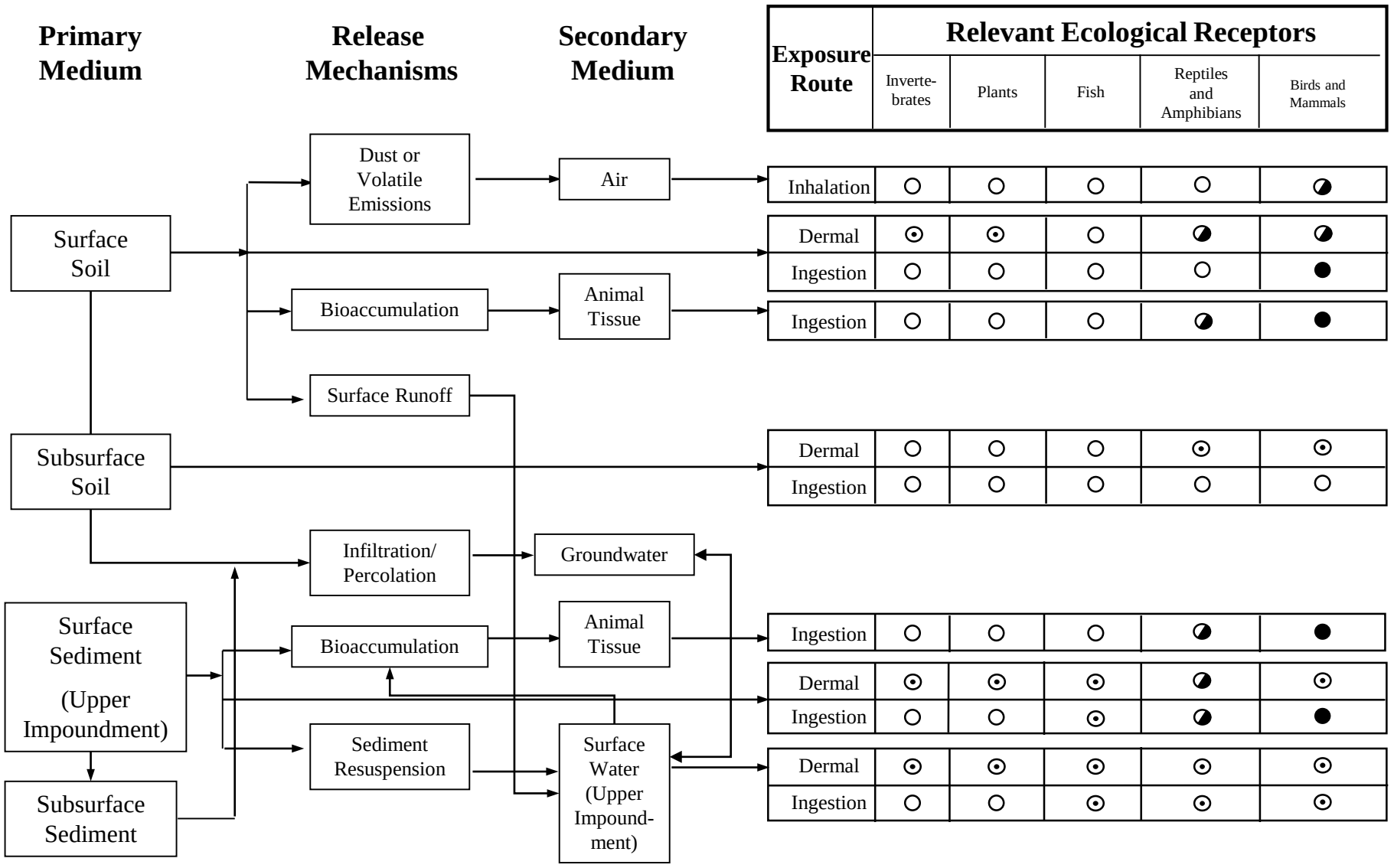
Date	Job Number		Figure
12/15/17	60540947	AECOM	2-1



- ● Potentially Complete Pathway
- ◪ Pathway Potentially Complete but Insufficient Toxicological Data
- ⊙ Pathway Potentially Complete but Insignificant or not quanitified
- ○ Pathway Incomplete

Exum Conceptual Site Model – Ecological

Date	Job Number		Figure
1/31/19	60540947	AECOM	2-2



- ● Potentially Complete Pathway
- ◪ Pathway Potentially Complete but Insufficient Toxicological Data
- ⊙ Pathway Potentially Complete but Insignificant or not quantified
- ○ Pathway Incomplete

Exum Conceptual Site Model – Ecological – Upper Impoundment

Date	Job Number		Figure
1/31/19	60540947	AECOM	2-3

Concentrations noted are for Benzo(a)pyrene (mg/kg), and Arsenic and n-Nitroso-di-n-phenalamine where noted (also mg/kg).

Colored circles note maximum sample depth of impacted areas proposed for removal (assuming a corrective action) in the risk scenario analyses:

-Yellow - 0-1 ft
-Orange - 4-6 ft
-Green - 8-10 ft
-Red - Samples not collected but assumed to warrant inclusion based on downgradient proximity to other samples

Upper Impoundment Impacted Area

MW-10
UI-SB-16 6.2
UI-SB-15 17 (NDP 17)
UI-SB-02 180 (As 220)
UI-SB-14 (As 140) 83
UI-SB-11 88
UI-SB-12 2000
UI-SB-13 1150 (As 190)
UI-SB-03 270
UI-SB-04 18
UI-SB-17 3
UI-SB-10
UI-SB-01 1900
UI-SB-8
UI-SB-9
UI-SD-10 250
UI-SB-7 2100
UI-SB-18 <1 (As 106)
UI-SD-03 200
UI-SD-04 150
UI-SD-05 73
UI-SB-6 21 (NDP 37)
UI-SB-25 1 (As 180)
UI-SD-11 120
UI-SD-01 100
UI-SB-5 5.9
UI-SB-30 <1 (As 140)
UI-SB-19 <1
UI-SD-08 600
UI-SD-06 12
UI-SD-07 160
UI-SD-02 6.3
UI-SD-09 350
UI-SB-28 4.3
UI-SB-35 <1
UI-SB-27 <1
UI-SB-33 5.6
UI-SB-31 <1
UI-SB-34 25
UI-SB-26 <1
UI-SB-20 <1
UI-SB-29 310
UI-SB-32 <1 (As 250)
UI-SB-22 84
UI-SB-21 2.1
UI-SB-23 <1 (As 195)
UI-SB-24

Figure 3-1

Exum Proposed Corrective Action Area
Upper Impoundment
Boring and Sample Location

United States Steel
Exum Facility
Fairfield, Alabama

N

Legend

- Phase II RFI Soil Borings
- Upper Pad Monitoring Well
- Upper Pad Soil Boring Location
- Sediment Sample
- Sediment and Surface Water Sample
- Approximate Unit Boundary
- Exum_Boundary
- Impacted Area

AECOM

0 40' 80' 160'
Feet (Approximate)

Source Image: AECOM Figure - UI Remedial Scenario Figure 1 Scenario 1G

I:\PROJECTS\CADD\US STEEL\US_STEEL_FAIRFIELD\UPPER IMPOUNDMENT\UPPER IMPOUNDMENT-00001-01A.DWG - FIGURE 3-1 - UI - Impacted Area - 8/28/2019 12:45:22 PM

Concentrations noted are for Benzo(a)pyrene (mg/kg), and Arsenic and n-Nitroso-di-n-phenalamine where noted (also mg/kg).

Colored circles note maximum sample depth of impacted areas proposed for removal (assuming a corrective action) in the risk scenario analyses:

-Yellow - 0-1 ft
-Orange - 4-6 ft
-Green - 8-10 ft
-Red - Samples not collected but assumed to warrant inclusion based on downgradient proximity to other samples

Slag Cover Over Upper Impoundment Impacted Soil Area

Mixed Soil/Sediment/Slag Cover System

MW-10
UI-SB-16 6.2
UI-SB-15 17 (NDP 17)
UI-SB-02 180 (As 220)
UI-SB-14 (As 140) 83
UI-SB-11 88
UI-SB-12 2000
UI-SB-13 1150 (As 190)
UI-SB-03 270
UI-SB-04 18
UI-SB-17 3
UI-SB-10
UI-SB-01 1900
UI-SB-8
UI-SB-9
UI-SD-10 230
UI-SB-7 2100
UI-SB-18 <1 (As 106)
UI-SD-03 200
UI-SD-04 350
UI-SD-05 73
21 (NDP 37)
UI-SB-6
UI-SB-25 1 (As 180)
UI-SD-11 120
UI-SD-01 100
UI-SD-08 600
UI-SD-06 2
UI-SD-07 160
UI-SD-02 6.3 350
UI-SD-09
5.9
UI-SB-5
UI-SB-30 <1 (As 140)
UI-SB-19 <1
UI-SB-28 4.3
UI-SB-35 <1
UI-SB-27 <1
UI-SB-33 5.6
UI-SB-31 <1
UI-SB-34 25
UI-SB-26 <1
UI-SB-20 <1
UI-SB-29 310
UI-SB-32 <1 (As 250)
UI-SB-22 84
UI-SB-21 2.1
UI-SB-23 <1 (As 195)
UI-SB-24

Figure 4-1

Exum Proposed Corrective Action Area Upper Impoundment

United States Steel
Exum Facility
Fairfield, Alabama

N

Legend

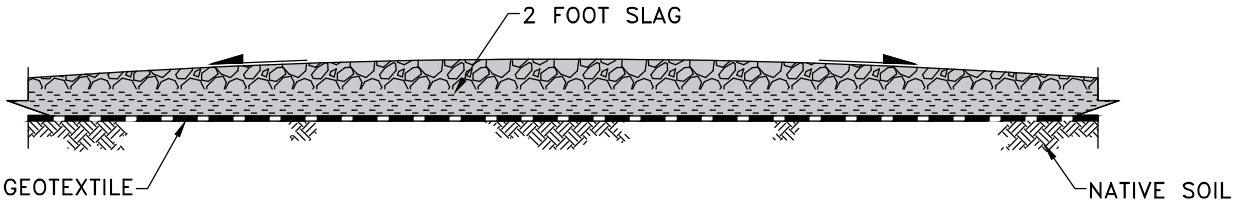
- Phase II RFI Soil Borings
- Upper Pad Monitoring Well
- Upper Pad Soil Boring Location
- Sediment Sample
- Sediment and Surface Water Sample
- Approximate Unit Boundary
- Exum_Boundary
- Impacted Area
- Mixed Sediment and Soil with Cover System

AECOM

0 40' 80' 160' Feet (Approximate)

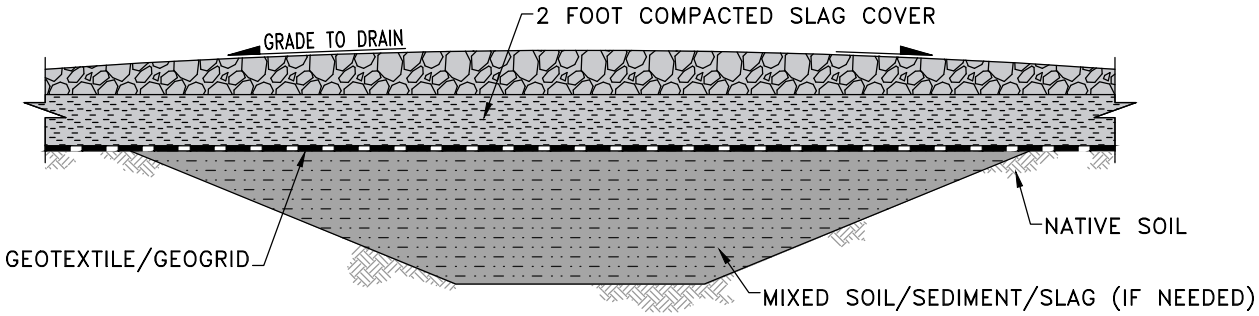
Source Image: AECOM Figure - UI Remedial Scenario Figure 1 Scenario 1G

I:\PROJECTS\CADD\US STEEL\US_STEEL_FAIRFIELD\UPPER IMPOUNDMENT\UPPER IMPOUNDMENT-00001-01A.DWG - FIGURE 4-1 - UI - Alt-4 - 8/28/2019 12:45:56 PM



TYPICAL SECTION – SLAG COVER OVER UPPER IMPOUNDMENT SOIL AREA

N.T.S.



TYPICAL SECTION – MIXED SLAG SOIL/SEDIMENT/SLAG COVER SYSTEM – UPPER IMPOUNDMENT POND AREA

N.T.S.

Figure 4-2

Exum Proposed Corrective Action Area Cover Cross Sections

Former Coke Plant Area
U.S. Steel Fairfield Works
Fairfield, Alabama

AECOM

I:\PROJECTS\CADD\US STEEL\US_STEEL_FAIRFIELD\UPPER IMPOUNDMENT\UPPER IMPOUNDMENT-00001-02.DWG – FIGURE 4-2 COVER CROSS SECTIONS – 8/28/2019 8:53:23 AM

APPENDIX A

ENVIRONMENTAL COVENANT – EXUM

ENVIRONMENTAL COVENANT

UNITED STATES STEEL CORPORATION, a Delaware corporation (hereinafter "Grantor"), pursuant to The Alabama Uniform Environmental Covenants Act, Ala. Code §§ 35-19-1 to 35-19-14 (2014 Cum. Supp.) (hereinafter "the Act" or "Act"), and the regulations promulgated thereunder, grants this Environmental Covenant (hereinafter the "Covenant") to the **ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT** (hereinafter "ADEM") this the ____ day of _____, 2021.

WHEREAS, the Grantor is the owner of approximately 398.7 acres of real property bounded by New Mulga Loop Road to the north, Tin Mill Road/10th Avenue to the east, and by Pleasant Grove Road to the south in the city of Birmingham, Jefferson County, Alabama known as the Exum Materials Management Area (hereinafter "the Property"). The legal description more particularly describing the Property is located in Exhibit A and a drawing depicting the Property is located in Exhibit B attached hereto;

WHEREAS, this instrument is an Environmental Covenant developed and executed pursuant to the Act and the regulations promulgated thereunder;

WHEREAS, the assessment work revealed that, at some time in the past industrial operations resulted in certain "Identified Contaminants" described below being been placed on the Property;

WHEREAS, Pursuant to the Alabama Hazardous Wastes Management and Minimization Act, the Property has conducted Corrective Action activities in accordance to ADEM rules and regulations;

WHEREAS, A Corrective Measures Implementation Plan (CMIP) was approved by ADEM on _____. The CMIP addresses the control of Identified Contaminants in certain areas of the Property. These Identified Contaminants include the following Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs) and Inorganic Compounds:

Exum Materials Management Area Identified Contaminants			
VOCs	SVOCs (Including PAHs)	Inorganics (Metals)	Misc. Inorganics
Benzene	2-Methylnaphthalene, Acenaphthylene, Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k) fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Fluoranthene, Fluorene, Naphthalene, Phenanthrene, Pyrene, n-Nitrosodi-n-propylamine Dibenzofuran, and Carbazole	Arsenic, Iron, Manganese, Nickel, Zinc, and Mercury	Cyanide

Further information concerning the Identified Contaminants, and the activities to correct the effects of the Identified Contaminants, may be obtained by contacting ADEM's Chief, Land Division, or his or her designated representative, at ADEM's address identified below; and

WHEREAS, the purpose of this Covenant is to ensure protection of human health and the environment by placing restrictions on the Property to reduce the risk to human health to below the target risk levels for those Identified Contaminants that remain beneath the Property;

WHEREAS, notwithstanding the fact that only certain areas of Property contains Identified Contaminants, Grantor has elected to place this Covenant and certain restrictions on the entire Property;

WHEREAS, the Administrative Record concerning the Property is located at:

Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110

NOW, THEREFORE, Grantor hereby grants this Covenant to ADEM and declares that the Property shall hereinafter be bound by, held, sold, used, improved, occupied, leased, hypothecated, encumbered, and/or conveyed subject to the following requirements set forth in paragraphs 1 through 3 below:

1. **DEFINITIONS**

Owner. "Owner" means the titleholder of the Property pursuant to a valid conveyance or other transfer of title pursuant to applicable law.

2. **USE RESTRICTIONS**

The following shall not take place on the Property:

(A) The development or use of the Property for residential purposes;

(B) The use of onsite groundwater for potable or irrigation purposes on or off the Property; and,

(C) Any excavation on the Property shall comply with the Soil Management Plan attached hereto as Exhibit C and incorporated herein by reference.

3. **GENERAL PROVISIONS**

A. **Restrictions to Run with the Land.** This Covenant runs with the land pursuant to Ala. Code §35-19-5 (2014 Cum Supp.); is perpetual, unless modified or terminated pursuant to the terms of this Covenant pursuant to Ala. Code §35-19-9 (Cum Supp. 2014); is imposed upon the entire Property unless expressly stated as applicable only to a specific portion thereof; inures to the benefit of and passes with each and every portion of the Property; and binds the Owner, all persons using the land, all persons, their heirs, successors and assigns having any right, title or interest in the Property, or any part thereof who have subordinated those interests to this Covenant, and all persons, their heirs, successors and assigns who obtain any right, title or interest in the Property, or any part thereof after the recordation of this Covenant.

B. **Notices Required.** In accordance with Ala. Code §35-19-4(b) (2014 Cum Supp.), the Owner shall send written notification, pursuant to Section I, below, following transfer, or concerning proposed changes in use of, or proposals for site work affecting the contamination on, the Property. Said notification shall be sent within fifteen (15) days of each event listed in this Section.

C. **Registry/Recordation of Environmental Covenant; Amendment; or Termination.** Pursuant to Ala. Code §35-19-12(b) (2014 Cum Supp.), this Covenant and any amendment or termination thereof, shall be contained in ADEM's registry for environmental covenants. After an environmental covenant, amendment, or termination is filed in the registry, a notice of the covenant, amendment, or termination may be recorded in the land records in lieu of recording the entire covenant in compliance with §35-19-12(b). Grantor shall be responsible for filing the Covenant within thirty (30) days of the final required signature upon this Covenant.

D. **Compliance Certification.** Reserved.

E. **Right of Access.** The Owner acknowledges ADEM's reasonable right of access to the Property for implementation or enforcement of this Covenant pursuant to applicable law.

F. **ADEM Reservations.** Notwithstanding any other provision of this Covenant, ADEM retains all of its access authorities and rights provided for under Alabama State Law, as well as all of its enforcement authorities under Alabama State environmental statutes.

G. **Representations and Warranties.** To the best of Grantor's knowledge, Grantor hereby represents and warrants to the other signatories hereto:

(i) That the Grantor has the power and authority to enter into this Covenant, to grant the rights and interests herein provided and to carry out all obligations hereunder;

(ii) That the Grantor is the sole owner of the Property and holds fee simple title which is free and clear of any liens or encumbrances that would negatively impact the applicability and enforceability of this Covenant;

(iii) That this Covenant will not materially violate, contravene, or constitute a material default under, any other agreement, document, or instrument to which Grantor is a party, by which Grantor may be bound or affected;

(iv) That this Covenant will not materially violate or contravene any zoning law or other law regulating use of the Property;

(v) That this Covenant does not authorize a use of the Property which is otherwise prohibited by a recorded instrument that has priority over the Covenant.

H. **Compliance Enforcement.** In accordance with Ala. Code §35-19-11(b) (2014 Cum. Supp.), the terms of the Covenant may be enforced by the parties to this Covenant; any person to whom this Covenant expressly grants power to enforce; or a municipality or other unit of local government in which the real property subject to the Covenant is located, in accordance with applicable law. Failure to timely enforce compliance with this Covenant or the use or activity limitations contained herein by any person shall not bar subsequent enforcement by such person and shall not be deemed a waiver of the person's right to take action to enforce any non-compliance. Nothing in this Covenant shall restrict ADEM, or the Grantor, from exercising any authority under applicable Alabama State law.

I. **Modifications/Termination.** Any modifications or terminations to this Covenant must be made in accordance with Ala. Code §§35-19-9 and 35-19-10 (2014 Cum. Supp.).

J. **Notices.** Any document or communication required to be sent pursuant to the terms of this Covenant shall be sent to the following persons:

ADEM

Chief, Land Division
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110

Grantor

United States Steel Corporation
General Manager – Real Estate
600 Grant Street
Pittsburgh, PA 15219

United States Steel Corporation
1350 Penn Avenue, Suite 200

Pittsburgh, Pennsylvania 15222-4211
Attn: Environmental Remediation

K. **No Property Interest Created in ADEM.** This Covenant does not in any way create any interest by ADEM in the Property that is subject to the Covenant. Furthermore, the act of approving this Covenant does not in any way create any interest by ADEM in the Property in accordance with Ala. Code §35-19-3(b) (2014 Cum. Supp.).

L. **Severability.** If any provision of this Covenant is found to be unenforceable in any respect, the validity, legality, and enforceability of the remaining provisions shall not in any way be affected or impaired.

M. **Governing Law.** This Covenant shall be governed by and interpreted in accordance with the laws of the State of Alabama.

N. **Recordation.** In accordance with Ala. Code §35-19-8(a) (2014 Cum. Supp.), Grantor shall record this Covenant and any amendment or termination of the Covenant in every county in which any portion of the real property subject to this Covenant is located. Grantor agrees to record this Covenant within thirty (30) days after the date of Grantor's receipt of the final required signature upon this Covenant.

O. **Effective Date.** The effective date of this Covenant shall be the date upon which the fully executed Covenant has been recorded, in accordance with Ala. Code §35-19-8(a) (2014 Cum. Supp).

P. **Distribution of Covenant.** Within fifteen (15) days of filing this Covenant, the Grantor shall distribute a recorded and date stamped copy of the recorded Covenant in accordance with Ala. Code §35-19-7(a) (2014 Cum. Supp.). However, the validity of this Covenant will not be affected by the failure to provide a copy of the Covenant as provided herein.

Q. **ADEM References.** All references to ADEM shall include successor agencies, departments, divisions, or other successor entities.

R. **Grantor References.** All references to the Grantor shall include successor agencies, departments, divisions, or other successor entities

S. **Other Applicable Party(ies).** All references to Other Applicable Party(ies) shall include successor agencies, departments, divisions, or other successor entities

T. **Release of Grantor.** Notwithstanding anything contained in this Covenant to the contrary if Grantor executes a valid conveyance or transfer of title to a new Owner, then Grantor shall be forever fully released from any and all obligations created by this Covenant on or after the date of conveyance or transfer, and the new Owner shall be required to fulfill such obligations.

IN TESTIMONY WHEREOF, the parties have hereunto set their hands this the day and year first above written.

Grantor has caused this Environmental Covenant to be executed pursuant to The Alabama Uniform Environmental Covenants Act, as of the date set forth above.

GRANTOR:

This Environmental Covenant is hereby approved by United States Steel Corporation, a Delaware corporation this ___ day of _____, 2021.

By: _____
Name: William Hinckley
Title: General Manager - Real Estate

Commonwealth of Pennsylvania)
)
County of Allegheny)

I, the undersigned notary public in and for said County in said State or Commonwealth, hereby certify that William P. Hinckley, whose name as General Manager Real Estate of United States Steel Corporation, a Delaware corporation, is signed to the foregoing conveyance and who is known to me, acknowledged before me on this day that, being informed of the contents of the conveyance, he, as such officer and with full authority executed the same voluntarily for and as the act of said corporation.

Given under my hand this the ____ day of _____, 2021

Notary Public: _____

My Commission Expires: _____

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

This Environmental Covenant is hereby approved by the State of Alabama this ___ day of _____, 2021

By: _____

Stephen A. Cobb
Chief, Land Division
Alabama Department of Environmental Management

State of Alabama)
)
Montgomery, County)

I, the undersigned Notary Public in and for said County and State, hereby certify that Stephen A. Cobb, whose name as Chief, Land Division, Alabama Department of Environmental Management is signed to the foregoing conveyance, and who is known to me, acknowledged before me on this day that, being informed of the contents of the conveyance, he approved the same voluntarily on the day the same bears date and with full authority to do so.

Given under my hand and official seal this ____ day of _____, 2021

_____
Notary Public

My Commission Expires: _____

STATE OF ALABAMA

COUNTY OF JEFFERSON

I, _____, Clerk of the Jefferson County Court, do certify that the foregoing Environmental Covenant *[and, if applicable, attached Subordination Agreement]* was lodged in my office for record, and that I have recorded it, this ___ day of _____, 2021 in the Deed Recordation Book _____ on Page _____.

_____
County Clerk

This instrument prepared by:

United States Steel Corporation
600 Grant Street
Pittsburgh, PA 15219

EXHIBIT A
[LEGAL DESCRIPTION OF ENTIRE PARCEL]

ACREAGE
LEGAL DESCRIPTION

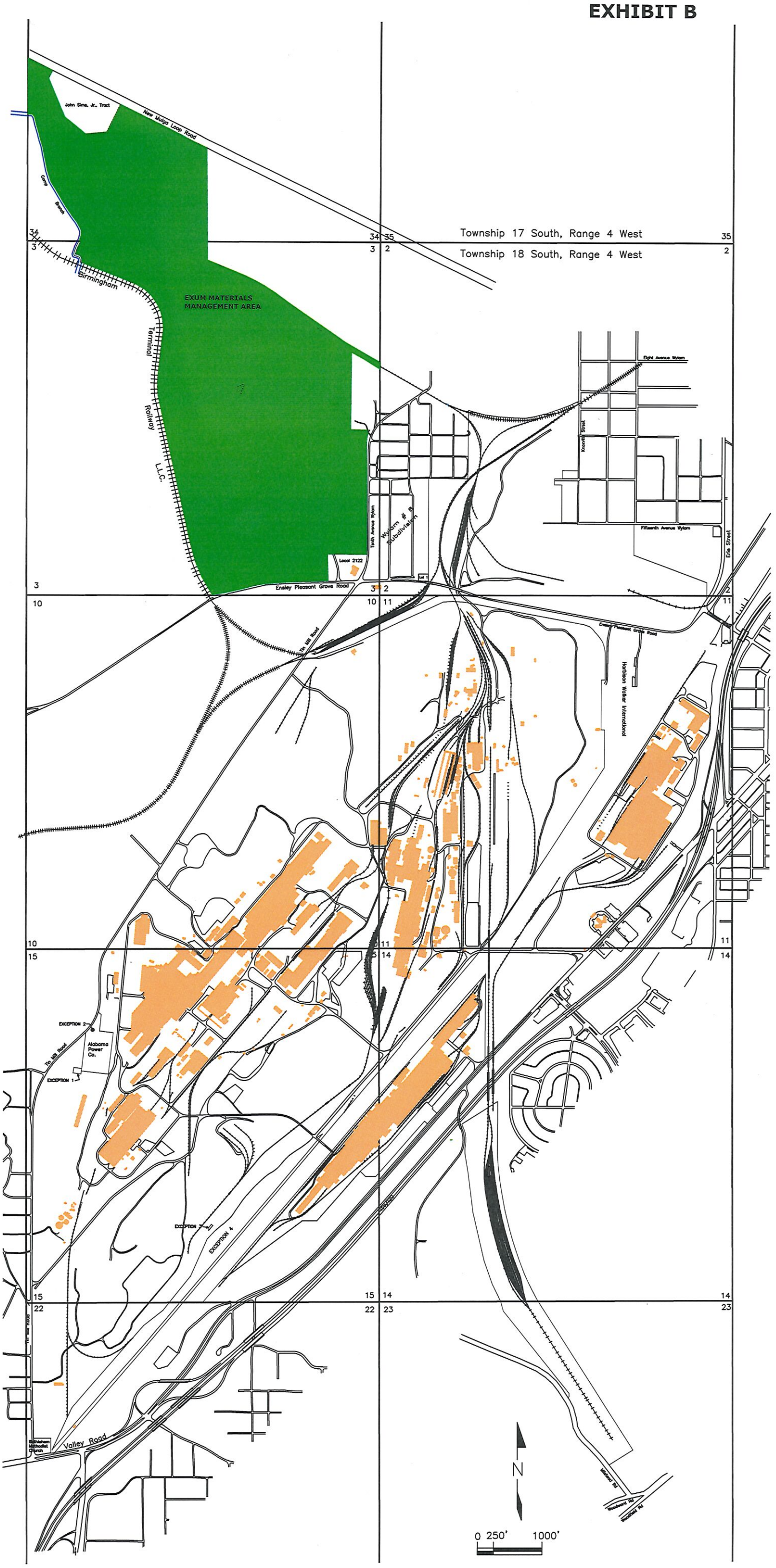
A tract of land located in Section 34, Township 17 South, Range 4 West and Section 3, Township 18 South, Range 4 West, of the Huntsville Principal Meridian, Jefferson County, Alabama, that was conveyed to Grantor and recorded in the Office of the Judge of Probate for Jefferson County, Alabama, by deed dated December 28, 1886 in Deed Book 78 Page 559, deed dated November 25, 1911 in Deed Book 692 Page 621, deed dated May 17, 1905 in Deed Book 394 Page 542, deed dated December 9, 1902 in Deed Book 324 Page 36, and deed dated December 7, 1951 in Deed Book 4801 page 391, described as follows:

BEGIN at the Southeast corner of the Southeast ¼ of the Southwest ¼ of said Section 34, Township 17 South, Range 4 West; thence in a Northerly direction along East line of said Southeast ¼ of the Southwest ¼ and the East line of the Northeast ¼ of the Southwest ¼ a distance of 1500 feet, more or less, to the Southern boundary of a public road (the New Mulga Loop Road); thence left in a Northwesterly direction along the South boundary of said road a distance of 1470 feet, more or less, to a tract of land conveyed by USX Corporation to John Sims, Jr., by deed dated October 3, 1991; thence turn a angle of 90° 00' 00" to the left in a Southwesterly direction along said Sims Tract a distance of 457.35 feet; thence turn an angle of 58° 30' 40" to the right in a Southwesterly direction along said Sims Tract a distance of 301.10 feet; thence turn an angle of 42° 50' 55" to the right in a Northwesterly direction along the Sims Tract a distance of 388.52 feet; thence turn an angle of 28° 58' 05" to the right in a Northwesterly direction along said Sims Tract a distance of 606.55 feet; thence turn an angle of 49° 39' 22" to the right in a Northerly direction along said Sims Tract a distance of 145.43 feet to the Southern boundary of said New Mulga Loop Road; thence leaving said Sims Tract turn an angle of 89° 59' 20" to the left in a Northwesterly direction along said road boundary a distance of 399.51 feet, more or less, to the West line of said Section 34; thence left in a Southerly direction along the West line of said Section 34 a distance of 810 feet, more or less, to the center line of Camp Branch; thence in a Southeasterly direction along the meanders of the center line of said Camp Branch to Northeastern boundary of a tract of land conveyed by Birmingham Southern Railroad Company to Birmingham Terminal Railway, L.L.C., by deed dated January 25, 2012; thence in a Easterly, Southerly and Southeasterly direction along the boundary of the Birmingham Terminal Railway Tract to the Northern boundary of a public road (the Ensley Pleasant Grove Road); thence left in a Easterly direction along the Northern boundary of said Ensley Pleasant Grove Road a distance of 1864.87, more or less, to the boundary of a tract of land conveyed by United States Steel Corporation to the Local 2122 Realty Corporation, Inc., by deed dated November 18, 1958, thence turn an angle of 88° 07' 30" to the left in a Northerly direction along said Local 2122 Tract a distance of 400.00 feet; thence turn an angle of 90° 17' 00" to the right in a Easterly direction along said Local 2122 Tract a distance of 526.40 feet to the West boundary of a public road (10th Avenue Wylam); thence left in a Northerly direction along said Road boundary to the North line of the Northeast ¼ of the Southeast ¼ of said Section 3; thence left in a Westerly direction along said North line to a point that is 400.00 feet West of the Northeast corner of the Northeast ¼ of the Southeast ¼ of said Section 3; thence turn an angle of 90° 00' 00" to the right in

a Northerly direction a distance of 1164.00 feet; thence turn an angle of 119° 21’ 00” to the right in a Southeasterly direction a distance of 210.50 feet; thence turn an angle of 19° 39’ 00” to the left in a Southeasterly direction a distance of 148.66 feet; thence turn an angle of 19° 39’ 00” to the right in a Southeasterly direction a distance of 80.3 feet, more or less, to the East line of said Section 3; thence left in a Northerly direction along said East Section line to a point that is 57.33 feet north of the center line of a rail line that is owned by United States Steel Corporation; thence left in a Northwesterly direction, 50.0 feet from and parallel to said railroad to the intersection with the West line of the Northwest ¼ of the Northeast ¼ of said Section 3; thence right in a Northerly direction along said West line to the **POINT OF BEGINNING**. As shown on attached map marked Exhibit B, containing 398.7 acres, more or less.

EXHIBIT B
[DRAWING OF PROPERTY]

EXHIBIT B



Section 34, Township 17 South, Range 4 West; and Section 3 Township 18 South, Range 4 West, Jefferson County, Alabama

The Property

EXHIBIT C
[SOIL MANAGEMENT PLAN]

AECOM Imagine it. Delivered.

Submitted to
United States Steel Corporation
Penn Liberty Plaza 1
1350 Penn Ave., Ste. 200
Pittsburgh, PA 15222

Submitted by
AECOM
1000 Corporate Centre Dr., Ste 250
Franklin, TN 37067
March 31, 2021

United States Steel Corporation

Exum Materials Management Area Soil Management Plan

EPA ID No. ALD 002 904 506

United States Steel Corporation
Fairfield Works Facility
5700 Valley Road
Fairfield, Alabama

Table of Contents

List of Figures

List of Acronyms

ADEM	Alabama Department of Environmental Management
AECOM	AECOM Technical Services, Inc.
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
PID	photo-ionization detector
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SWMU	Solid Waste Management Unit
SVOC	Semi-Volatile Organic Compound
UECP	Uniform Environmental Covenants Program
U. S. EPA	United States Environmental Protection Agency
U. S. Steel	United States Steel corporation
VOC	Volatile Organic Compound

1 Introduction

United States Steel Corporation (U. S. Steel) has retained AECOM Technical Services, Inc. (AECOM) to develop this Soil Management Plan (the Plan) for implementation during future site work at the U. S. Steel Exum Materials Management Area, Fairfield, Jefferson County, Alabama (Exum or the site) (see **Figure 1-1**). This Plan outlines required management practices to minimize exposure to and manage soil, potentially containing chemicals of interest (VOCs and SVOCs) during site activities.

1.1 Site Location and General Use Description

Exum is located approximately one-mile northwest of Fairfield Works near the communities of Pleasant Grove, Exum, and Wylam (see **Figure 1-1**) and is accessible by both roadway and rail. The Exum facility is bounded on the north by New Mulga Loop Road; on the east by Tin Mill Road/10th Avenue; on the south by Pleasant Grove Road; and on the west by Camp Branch creek and an active railroad line.

Exum Materials Management Area (Exum) was identified as one of 51 solid waste management units (SWMUs) associated with the U. S. Steel Fairfield Works facility (Fairfield Works). Exum was designated as SWMU 23. The Alabama Department of Environmental Management (ADEM) issued RCRA Post-Closure Care Permit No. ALD 002 904 506 (the Permit) to U. S. Steel on February 8, 1999, as modified on June 7, 2017 (ADEM, 2017a). The site and surrounding properties are currently owned by U. S. Steel and have been used for industrial purposes (steel production) since 1912. It is unreasonable to expect any future land use beyond commercial/industrial purposes. In addition, land use controls through application of an environmental covenant for Exum is proposed that will restrict future land use to industrial only.

Exum consists of approximately 230 acres and was previously used for storage of raw materials used by Fairfield Works, the storage of co-products of the iron and steel making operations, and management of non-hazardous wastes (blast furnace and QBOP sludge, dust, and other plant waste) generated at Fairfield Works. Operations at Exum began in the early 1940s to store co-product slag produced at Fairfield Works. Slag constitutes the largest volume of fill material at Exum and was used to contour the Upper and Lower Pads for material storage. Exum is currently inactive and residual raw materials and other co-products previously stockpiled on the Upper and Lower Pads have been removed and are no longer present except for existing mill scale stored on the Lower Pad for recycling.

1.2 Project Background

Each area of Exum is shown on **Figure 1-2**. Based on the results of the Phase I RFI, no further action was recommended for the Upper and Lower Pads, BF/QBOP Sludge Disposal Area, and Camp Branch. Additional delineation activities were recommended for the Upper and Lower Impoundments. Subsequent installation of Exum Phase II RFI soil borings and monitoring wells were completed and sampled in 2017. The Exum Phase II RFI Report dated January 24, 2018, as revised April 13, 2018 to include March 21, 2018 ADEM comments (Revision 1 Report) documented the Exum Phase II RFI field activities and findings. Based on findings documented in the Revision 1 Report, additional investigation activities were performed at the Upper Impoundment, Pipe Mill Varnish Area, and an evaluation of the soil to groundwater migration pathway was completed. The results of the additional investigation activities were incorporated into the Exum Phase II RFI Report, Revision 2 (Revision 2 Report) (AECOM, 2019b). The Phase II RFI Report was approved by ADEM via letter dated May 6, 2019.

An environmental covenant has been developed for Exum in accordance with the Uniform Environmental Covenants Program (UECP), ADEM Administrative Code 335-5, effective October 4, 2019. The intent of the environmental covenant is to reduce potential risks to human health and/or environment by restricting activity and land use at Exum. Environmental Covenants administered through ADEM pertain to sites where impacted media (e.g., soil) remain in place at concentrations prohibiting unrestricted use (i.e., would prohibit residential use).

1.3 Purpose and Use

This Plan has been prepared to address the potential presence of impacted soil. Prior to performing soil grading and subsurface excavation at the Site, the entities performing the work, including but not limited to the site owner or operator contractors, and subcontractors must review this plan prior to the commencement of work activities. The Plan will be made available as a reference to any company or individual conducting subsurface work at the Site. It is the responsibility of each company or contractor to ensure that the Plan is reviewed and understood by all its employees and subcontractors who perform soil grading and subsurface work at the Site.

This document is not an Occupational Safety and Health Administration (OSHA) Health and Safety Plan. For work conducted at the Site, each company or contractor is responsible for the training and safety of all its employees, agents and subcontractors, and for worker protection at levels required by applicable regulations. Each company or contractor is responsible for the determination of the appropriate level of worker protection at all times.

2 Worker and Environment Protection

Due to the potential presence of residual impacts in the subsurface due to the previous use of the Site, precautionary measures should be taken to protect on-site workers and the environment during soil excavation and grading activities as described below.

2.1 Protective Measures for On-Site Workers

During excavation of soil, exposure of on-site workers to chemicals of interest may potentially occur through dermal contact, inhalation, or incidental ingestion of contaminated materials. When conditions warrant, exposure can be reduced by the following precautions:

- Minimize worker contact with contaminated materials including wearing the appropriate personal protective equipment (PPE) as required and specified in the Contractor's Site-specific Health and Safety Plan(s), such as gloves, long pants and long-sleeved shirts, coveralls, boots and overshoes, and safety glasses.
- Work practices such as wetting of soils should be implemented as necessary to minimize dust.
- Workers should properly remove PPE and wash their hands and any other exposed body parts prior to leaving the work area, eating, drinking, or performing other activities.

2.2 Protective Measures for the Environment

Appropriate material management practices should be employed to minimize environmental impacts if impacted material is encountered. After ensuring worker safety, the priority is to prevent the existing chemical impact from spreading to other areas. Measures should be taken by the Contractor to prevent the spread of impacted soil by wind, contact water run-off, or physical spreading of materials, including minimizing generation of dust, and preventing vehicle or equipment tracking.

2.3 Site Security and Facilities

Access to the Site is restricted. During work hours, traffic cones, caution tape, and signs can be used to inform persons of restricted work areas. The company or contractor is responsible for redirecting all traffic away from the restricted locations. Areas identified during construction that have the potential to be impacted can be surrounded by barricades such as caution tape, cones or physical barriers as deemed necessary to keep unauthorized personnel out of the work area and away from the identified work areas.

3 Soil Management

In the event of the discovery of stained or odorous soil during Site work activities, that is determined to potentially be impacted by chemicals, the suspected impacted soil must be managed according to federal, state, and local rules and regulations. The soil management practices must consider the following:

- Exposure to humans and the environment must be prevented.
- If impacted soil is observed, laboratory analysis of the soil must occur prior to disposal off-site.
- The original location, laboratory results, and final disposition of the soil must be documented.

3.1 Encountering Suspect Impacted Soil

If suspected impacted soil is encountered during project activities (as evidenced by visual, olfactory, or photo-ionization detector (PID) observations), the contractor shall notify the site owner or operator (or representative of the site owner or operator) that is responsible for day to day activities and environmental management at the site.

The Contractor will comply with the provisions of an ADEM-approved National Pollutant Discharge Elimination System (NPDES) general permit if required for soil management along with the Best Management Practices that are included. Contractor field personnel shall incorporate appropriate controls (i.e., silt fencing, hay bales, or other mitigation measures) to reduce or eliminate sediment runoff into Waters of the State.

If waste is generated which is required to be transferred offsite, the Contractor will implement appropriate measures to segregate and properly manage potentially affected media, if encountered, during grading and/or excavation activities. Such materials will be handled and managed in accordance with ADEM Division13 and Division 14 regulations.

Waste material generated during grading or excavation activities will be characterized and staged in accordance with ADEM Administrative Code 335-14-2 for waste determination requirements. Representative sampling and analysis of the waste will be conducted to determine whether it exhibits one of the characteristics found at ADEM Admin. Code r. 335-14-2-.03. A representative sample is required to properly characterize a waste stream using sampling and analysis.

Upon characterization of the generated waste the Site Representative will complete and submit ADEM Form 300 for review and approval by the Solid Waste Branch and dispose of any waste in accordance with the requirements.

Additional precautions such as those listed below may also be implemented:

- Cover exposed material (i.e., excavation and stockpile areas) at the end of each day while being excavated to prevent worker exposure or dust generation, and to minimize the potential for storm water to accumulate in the excavation and contact the impacted soil.
- Place excavated soil that is known or suspected of being impacted in appropriate containers or temporarily on plastic sheeting (6-mil or greater) and cover with plastic sheeting until the laboratory results are received and the appropriate action is determined.

3.2 Record Keeping

The following information must be maintained.:

- Location and date impacted soil was encountered by the company or contractor (as ascertained from the Contractor).
- Date and location of soil samples, chain-of-custody documentation, laboratory analysis performed on the soil samples, and analytical testing results, if required.
- If impacted soil is transported off-site, document the name of the transport company, the date and amount of soil transported off-site, and the disposal facility.

4 References

ADEM. 2017a. RCRA Post Closure Care Permit ALD 002 904 506. June.

AECOM. 2019a. United States Steel Corporation Fairfield Works Corrective Measures Implementation Plan – Revision 1, E PA ID No. ALD 002 904 506, January.

AECOM. 2019b. United States Steel Corporation Exum Materials Management Area Phase II RFI Report (Revision 2), EPA ID No. ALD 002 904 506. February.

URS. 2002. Phase I RCRA Facility Work Plan – U. S. Steel Fairfield Works. Prepared for U. S. Steel Corporation, Pittsburgh, PA by URS Corporation. June 2002.

URS. 2005. Phase I RCRA Facility Investigation Report, U. S. Steel Fairfield Works, Fairfield, AL. December 21, 2005.

URS. 2011. Exum RFI Work Plan, Phase II RFI Work Plan Addendum, Exum Materials Management Area, Fairfield Works, Jefferson County, Alabama. August 18, 2011.

URS. 2012. Exum Phase I RFI Report, Exum Materials Management Area, Fairfield Works, Jefferson County, Alabama. June 20, 2012.

URS. 2013. Exum Phase I RFI Report Addendum, Groundwater Investigation, Exum Materials Management Area, Fairfield Works, Jefferson County, AL. January 18, 2013.

FIGURES

Figure 1-1

Site Layout Map

Unites States Steel
Exum Facility
Fairfield, Alabama

N

Fairfield Works Facility Boundary

Exum Property Boundary

Exum Facility Boundary

AECOM

0 0.1 0.2 0.4

Miles

Ensley Slag Recovery Area

Exum Materials Management Area

Fairfield Works

Junction
Tailings
Edgewater
Tipple
Substation
Gary-Ensley Sch
West Ensley
BIRMINGPORT
MC DONALD
McDonald Chapel
BM 578
SOUTHERN
Camp
Loop
Substation
Branch
ROAD
Reservoir
Hobson
Wylam
Exum
BM 651
Falls Jun
Tailings
Ensley
BIRMINGHA
Slag Dump
Water
Fuel
Elliott
Yard
Dump
Grove Estates
Westfield
Chemical
Ore Storage Area
Substation
Chemical
Water
Pumping Sta
Cooling Pond
NASHVILLE
SOUTHERN
Opossum

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Lower Pad

Camp Branch

Lower Impoundment

Upper Impoundment

Cross Tie Disposal Area

Upper Pad

Pipe Mill Varnish Area

Camp Branch

BF/QBOP Sludge Disposal Area

Figure 1-2

Site Layout Map

Unites States Steel
Exum Facility
Fairfield, Alabama

N

Property Boundary

Approximate Unit Boundary

Exum Boundary

AECOM

0 250 500 1,000

Feet

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APPENDIX B

PROSPECTIVE POST-CORRECTIVE ACTION RISK CALCULATIONS

Table 1
Exposure Parameters for the Industrial Worker - Exum
U. S. Steel Fairfield Works - Fairfield, AL

Exposure Pathway	Parameter	Description	Fairfield Works Fairfield, Alabama	
			RME	Source
Incidental Soil Ingestion	IR	Soil Ingestion Rate (mg/d)	75	(a)
	EF	Exposure Frequency (d/yr)	198	(c)
	ED	Exposure Duration (years)	25	(f)
	BW	Body Weight (kg)	70	(b,f,g)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	9125	(e)
	ATc	Averaging Time for Carcinogenic Effects (days)	25,550	(b,f,g)
Dermal Contact with Soil	SA	Skin Surface Area Exposed (cm^2)	1,930	(h)
	M	Dermal Adherence Rate (mg/cm^2)	0.2	(d)
	RAFd	Dermal Relative Absorption Factor (Unitless)	Chemical-specific	(k)
	CF	Conversion Factor (kg/mg)	1.00E-06	--
	EF	Exposure Frequency (d/yr)	198	(c)
	ED	Exposure Duration (years)	25	(f)
	BW	Body Weight (kg)	70	(b,f,g)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	9125	(e)
	ATc	Averaging Time for Carcinogens (days)	25,550	(b,f,g)
Inhalation of Soil Derived Chemicals	IR_{ao}	Hourly Outdoor Inhalation Rate (m^3/hour)	1.5	(i)
	ET	Exposure Time (hr/d)(site-/area-specific)	8	(j)
	EF	Exposure Frequency (d/yr)	198	(c)
	ED	Exposure Duration (years)	25	(f)
	BW	Body Weight (kg)	70	(b,f,g)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	9125	(e)
	ATc	Averaging Time for Carcinogens (days)	25,550	(b,f,g)

Notes:
RME - Reasonable Maximum Exposure
(a) RM-1 ingestion rate for commercial worker (ADEM 2008)
(b) USEPA 1991. Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.
(c) USEPA default value (250 days per year) in conjunction with a meteorological factor of 79% (see text).
(d) RM-1 dermal adherence rate for commercial worker (ADEM 2008)
(e) Averaging Time for noncarcinogens is equal to the Exposure Duration (in years) multiplied by 365 days/year (USEPA 1989).
(f) USEPA 1989. RAGS, Volume I, Human Health Evaluation Manual (Part A).
(g) 70 kg body weight and 70 year lifetime are used to be consistent with the development of cancer slope factors.
(h) USEPA 1997. Table 6-2 of Exposure Factors Handbook, Volume 1, represents the sum of the skin surface area for heads and hands (mean for male and female). All workers are required to wear long sleeve shirts, long pants, and shoes.
(i) RM-1 inhalation rate for commercial worker (ADEM 2008)
(j) USEPA 1997. Table 15-68 of Exposure Factors Handbook, Volume 3, 50th percentile value for time spent at work, males and females, all ages.
(k) RAFd values were selected based on values provided in RAGS, Part E (USEPA 2004).

Table 2
Exposure Parameters for Construction Worker - Exum
U. S. Steel Fairfield Works - Fairfield, AL

Exposure Pathway	Parameter	Description	Fairfield Works Fairfield, Alabama	
			RME	Source
Incidental Soil Ingestion	IR	Soil Ingestion Rate (mg/d)	177	(a)
	EF	Exposure Frequency (d/yr)	195	(d)
	ED	Exposure Duration (years)	1	(e)
	BW	Body Weight (kg)	70	(f,g,h)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	365	(k)
	ATc	Averaging Time for Carcinogenic Effects (days)	25,550	(f,g,h)
Dermal Contact with Soil	SA	Skin Surface Area Exposed (cm^2)	1,930	(i)
	M	Dermal Adherence Rate (mg/cm^2)	0.20	(b)
	RAFd	Dermal Relative Absorption Factor (Unitless)	Chemical-specific	(l)
	CF	Conversion Factor (kg/mg)	1.00E-06	--
	EF	Exposure Frequency (d/yr)	195	(d)
	ED	Exposure Duration (years)	1	(e)
	BW	Body Weight (kg)	70	(f,g,h)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	365	(k)
	ATc	Averaging Time for Carcinogens (days)	25,550	(f,g,h)
Inhalation of Soil Derived Chemicals	IR_{ao}	Hourly Outdoor Inhalation Rate (m^3/hour)	1.5	(c)
	ET	Exposure Time (hr/d)(site-/area-specific)	8	(j)
	EF	Exposure Frequency (d/yr)	195	(d)
	ED	Exposure Duration (years)	1	(e)
	BW	Body Weight (kg)	70	(f,g,h)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	365	(k)
	ATc	Averaging Time for Carcinogens (days)	25,550	(f,g,h)

Notes:
RME - Reasonable Maximum Exposure
(a) RM-1 ingestion rate for construction worker (ADEM 2008)
(b) RM-1 dermal adherence rate for construction worker (ADEM 2008)
(c) RM-1 inhalation rate for construction worker (ADEM 2008)
(d) 5 days per week for 9 months.
(e) Construction activities are assumed to occur over a 1 year period, ADEM (2008) RM-1 value.
(f) USEPA 1991. Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.
(g) USEPA 1989. RAGS, Volume I, Human Health Evaluation Manual (Part A).
(h) 70 kg body weight and 70 year lifetime are used to be consistent with the development of cancer slope factors.
(i) USEPA 1997. Table 6-2 of Exposure Factors Handbook, Volume 1, represents the sum of the skin surface area for heads and hands (mean values for males and females). All workers are required to wear long sleeve shirts, long pants and shoes.
(j) USEPA 1997. Table 15-68 of Exposure Factors Handbook, Volume 3, 50th percentile value for time spent at work, males and females, all ages.
(k) Averaging Time for noncarcinogens is equal to the Exposure Duration (in years) muliplied by 365 days/yr (USEPA 1989).
(l) RAFd values were selected based on values provided in RAGS, Part E (USEPA 2004).

Table 3
Exposure Parameters for Maintenance/Utility Worker - Exum
U. S. Steel Fairfield Works - Fairfield, AL

Exposure Pathway	Parameter	Description	Fairfield Works Fairfield, Alabama	
			RME	Source
Incidental Soil Ingestion	IR	Soil Ingestion Rate (mg/d)	177	(a)
	EF	Exposure Frequency (d/yr)	198	(c)
	ED	Exposure Duration (years)	25	(g)
	BW	Body Weight (kg)	70	(f,g,h)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	9125	(e)
	ATc	Averaging Time for Carcinogenic Effects (days)	25,550	(f,g,h)
Dermal Contact with Soil	SA	Skin Surface Area Exposed (cm^2)	1,930	(i)
	M	Dermal Adherence rate (mg/cm^2)	0.2	(b)
	RAFd	Dermal Relative Absorption Factor (Unitless)	Chemical-specific	(k)
	CF	Conversion Factor (kg/mg)	1.00E-06	--
	EF	Exposure Frequency (d/yr)	198	(c)
	ED	Exposure Duration (years)	25	(g)
	BW	Body Weight (kg)	70	(f,g,h)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	9125	(e)
	ATc	Averaging Time for Carcinogens (days)	25,550	(f,g,h)
Inhalation of Soil Derived Chemicals	IR_{ao}	Hourly Outdoor Inhalation Rate (m^3/hour)	1.5	(d)
	ET	Exposure Time (hr/d)(site-/area-specific)	8	(j)
	EF	Exposure Frequency (d/yr)	198	©
	ED	Exposure Duration (years)	25	(g)
	BW	Body Weight (kg)	70	(f,g,h)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	9125	(e)
	ATc	Averaging Time for Carcinogens (days)	25,550	(f,g,h)

Notes:
RME - Reasonable Maximum Exposure

(a) Maintenance worker ingestion rate based on RM-1 value for construction worker (ADEM 2008)
(b) Maintenance worker dermal adherence rate based on RM-1 value for construction worker (ADEM 2008)
(c) USEPA default value (250 days per year) in conjunction with a meteorological factor of 79% (see text).
(d) Maintenance worker inhalation rate based on RM-1 value for construction worler (ADEM 2008)
(e) Averaging Time for noncarcinogens is equal to the Exposure Duration (in years) muliplied by 365 days/yr (USEPA 1989).
(f) USEPA 1991b. Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.
(g) USEPA 1989. RAGS, Volume I, Human Health Evaluation Manual (Part A).
(h) 70 kg body weight and 70 year lifetime are used to be consistent with the development of cancer slope factors.
(i) USEPA 1997. Table 6-2 of Exposure Factors Handbook, Volume 1, represents the sum of the skin surface area for heads and hands (mean for males and females). All workers are required to wear long sleeve shirts, long pants, and shoes.
(j) USEPA 1997. Table 15-68 of Exposure Factors Handbook, Vol. 3, 50th percentile value of time spent at work, males and females, all ages.
(k) RAFd values were selected based on values provided in RAGS, Part E (USEPA 2004).

Table 4
Exposure Parameters for the Adolescent Trespasser
U.S. Steel, Fairfield Works, Fairfield, Alabama

Exposure Pathway	Parameter	Description	Fairfield Works Fairfield, Alabama	
			RME	Source
Incidental Soil Ingestion				
	IR	Soil Ingestion Rate (mg/d)	50	(a)
	EF	Exposure Frequency (d/yr)	52	(d)
	ED	Exposure Duration (years)	12	(e)
	BW	Body Weight (kg)	47	(f)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	4380	(n)
	AT_c	Averaging Time for Carcinogenic Effects (days)	25,550	(b,g,h)
Dermal Contact with Soil	SA	Skin Surface Area Exposed (cm^2)	3,677	(i)
	RAFd	Dermal Adherence Rate (mg/cm^2)	0.02	(j)
	CF	Conversion Factor (kg/mg)	1.00E-06	--
	EF	Exposure Frequency (d/yr)	52	(d)
	ED	Exposure Duration (years)	12	(e)
	BW	Body Weight (kg)	47	(f)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	4380	(n)
	AT_c	Averaging Time for Carcinogens (days)	25,550	(b,g,h)
Inhalation of Soil Derived Chemicals	IR^{ao}	Hourly Outdoor Inhalation Rate (m^3/hour)	1.0	(l)
	ET	Exposure Time (hr/d)(site-/area-specific)	2	(m)
	EF	Exposure Frequency (d/yr)	52	(d)
	ED	Exposure Duration (years)	12	(e)
	BW	Body Weight (kg)	47	(f)
	ATnc	Averaging Time for Non-carcinogenic Effects (days)	4380	(n)
	AT_c	Averaging Time for Carcinogens (days)	25,550	(b,g,h)

Notes:
RME - Reasonable Maximum Exposure.
(a) USEPA 1997. Exposure Factors Handbook. Average soil ingestion rate for older children and adults.
(b) USEPA 1991. Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.
(c) Conservative assumption (2 days/week during June, July, and August and 1 day/week during April, May, September, and October.)
(d) Conservative assumption (3 days/week during June, July, and August and 1 day/week during April, May, September, and October.)
(e) Adolescent trespasser is assumed to range in age from 7 to 18. Therefore, total exposure duration is 12 years.
(f) USEPA 1997. Exposure Factors Handbook. Body weight is the average of males and females aged 7 to 18.
(g) USEPA 1991. Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.
(h) 70 year lifetime is used to be consistent with the development of cancer slope factors.
(i) USEPA 1997. Exposure Factors Handbook. Average surface area of head, hands, forearms, and lower legs of males and females aged 7 to 18.
(j) Based on Exposure Factors Handbook, Volume 1, and Kissel et al. (1996) data for Soccer Kids.
(k) USEPA 1997. Exposure Factors Handbook. Average inhalation rate of males and females aged 7 to 18. Table 5-23.
(l) USEPA 1997. Exposure Factors Handbook. Inhalation rate for short-term exposure, light activity (adults and children). Table 5-23.
(m) Each trespassing event is assumed to last for 2 hours.
(n) Averaging Time for noncarcinogens is equal to the Exposure Duration (in years) muliplied by 365 days/yr (USEPA 1989).

Table 5
Summary of Cancer Risks and Non-Cancer Hazard Indices
Upper Impoundment - Exum
Post-Corrective Action Risk Analysis

U.S. Steel - Fairfield Works - Fairfield, Alabama

Receptor	Exposure Route	RME	
		HI	CR
Commercial/Industrial Worker	Ingestion	0.8	5E-05
	Dermal Contact	0.2	3E-05
	Inhalation (Particulates)	0.0	4E-08
	Inhalation (Vapors)	0.1	5E-06
	TOTAL	**1**	**9E-05**
Construction Worker	Ingestion	1.6	2E-06
	Dermal Contact	0.1	5E-07
	Inhalation (Particulates)	0.04	1E-09
	Inhalation (Vapors)	0.1	1E-07
	TOTAL	**2**	**3E-06**
Maintenance/Utility Worker	Ingestion	1.6	6E-05
	Dermal Contact	0.1	1E-05
	Inhalation (Particulates)	0.04	4E-08
	Inhalation (Vapors)	0.1	3E-06
	TOTAL	**2**	**8E-05**
Trespasser	Ingestion	0.21	6E-06
	Dermal Contact	0.12	8E-06
	Inhalation (Particulates)	0.003	1E-09
	Inhalation (Vapors)	0.010	2E-07
	TOTAL	**0.3**	**1E-05**

RME -Reasonable Maximum Expsosure
HI = Noncarcinogenic Hazard Index
CR = Carcinoginic Risk

Exposure Point Concentrations
Upper Impoundment - Exum
U.S. Steel Fairfield Works - Fairfield, Alabama

Analyte	Number of Samples	Number of Detections	Distribution	Maximum Detection	Mean of Detected	UCL Method*	UCL	EPC
SURFACE SOILS (0-1 ft) - Industrial Worker, Trespasser								
Inorganics (mg/kg)								
Arsenic	23	23	Lognormal	200	49.5	95% Chebyshev (Mean, SD)	99.3	99.3
Iron	23	23	Gamma, Approx. Lognormal	445000	215087	95% Adjusted Gamma	286507	286507
Manganese	23	23	Approx. Normal, Gamma, Approx. Lognormal	15000	7354	95% Student's t	9149	9149
Nickel	23	18	Lognormal	3400	248.3	95% KM Chebyshev	843.2	843.2
Zinc	23	23	Gamma, Lognormal	16000	3133	95% Adjusted Gamma	5536	5536
Mercury	21	21	Lognormal	11	0.751	95% Chebyshev (Mean, SD)	3.00	3.00
Cyanide	23	23	Gamma, Lognormal	6	1.808	95% Adjusted Gamma	2.71	2.71
Organics (ug/kg)								
2-Methylnaphthalene	17	23	Lognormal	23000	3690	Gamma Adjusted KM-UCL	7477	7477
Acenaphthylene	21	23	Lognormal	93000	8612	95% KM Chebyshev	27632	27632
Benzo(a)anthracene	19	23	Lognormal	500000	37339	95% KM Chebyshev	127029	127029
Benzo(a)pyrene	23	23	Lognormal	310000	22016	95% Chebyshev (Mean, SD)	81422	81422
Benzo(b)fluoranthene	23	23	Lognormal	530000	35808	95% Chebyshev (Mean, SD)	136896	136896
Benzo(k)fluoranthene	23	23	Lognormal	180000	12200	95% Chebyshev (Mean, SD)	46558	46558
Chrysene	23	23	Lognormal	440000	28154	95% Chebyshev (Mean, SD)	111714	111714
Dibenz(a,h)anthracene	23	13	Lognormal	55000	6163	95% KM Chebyshev	14293	14293
Fluoranthene	23	23	Lognormal	1600000	96304	95% Chebyshev (Mean, SD)	402733	402733
Fluorene	23	13	Gamma, Lognormal	54000	7268	Gamma Adjusted KM-UCL	16021	16021
Indeno(1,2,3-cd)pyrene	23	23	Lognormal	240000	17355	95% Chebyshev (Mean, SD)	63183	63183
Naphthalene	23	18	Non-parametric	230000	23811	95% KM Chebyshev	67135	67135
Phenanthrene	23	23	Lognormal	1300000	75472	95% Chebyshev (Mean, SD)	323803	323803
Pyrene	23	23	Lognormal	1000000	63654	95% Chebyshev (Mean, SD)	255063	255063
Carbazole	23	16	Lognormal	38000	3692	95% KM Chebyshev	9844	9844
Dibenzofuran	23	15	Lognormal	64000	8784	95% KM Chebyshev	20256	20256
Benzene	23	11	Gamma, Lognormal	440	140.6	Gamma Adjusted KM-UCL	176	176
N- Nitrosodi-n-propylamine	23	4	Normal, Gamma, Lognormal	37000	14850	95% KM (t)	5856	5856

Exposure Point Concentrations
Upper Impoundment - Exum
U.S. Steel Fairfield Works - Fairfield, Alabama

COMBINED SOILS (0-15 ft) - Maintenance/Utility Worker/Construction Worker								
Analyte								**EPC**
Inorganics (mg/kg)								
Arsenic	71	71	Lognormal	250	41.47	95% Chebyshev (Mean, SD)	69.55	69.55
Iron	71	71	Non-parametric	580000	207246	95% Chebyshev (Mean, SD)	296437	296437
Manganese	71	71	Non-parametric	31000	6550	95% Chebyshev (Mean, SD)	9722	9722
Nickel	71	56	Non-parametric	13000	323	95% KM (Chebyshev)	1078	1078
Zinc	71	71	Non-parametric	56000	4776	95% Chebyshev (Mean, SD)	9361	9361
Mercury	67	67	Lognormal	11	0.384	95% Chebyshev (Mean, SD)	1.102	1.10
Cyanide	71	62	Lognormal	17	1.376	95% KM (Chebyshev)	2.382	2.38
Organics (ug/kg)								
2-Methylnaphthalene	71	42	Approx. Lognormal	23000	1800	95% KM (Chebyshev)	2957	2957
Acenaphthylene	71	51	Lognormal	93000	4043	95% KM (Chebyshev)	9501	9501
Benzo(a)anthracene	71	50	Lognormal	500000	15328	95% KM (Chebyshev)	42301	42301
Benzo(a)pyrene	71	60	Approx. Lognormal	310000	9789	95% KM (Chebyshev)	27944	27944
Benzo(b)fluoranthene	71	60	Lognormal	530000	16122	95% KM (Chebyshev)	46980	46980
Benzo(k)fluoranthene	71	60	Lognormal	180000	5414	95% KM (Chebyshev)	15914	15914
Chrysene	71	61	Lognormal	440000	12278	95% KM (Chebyshev)	38034	38034
Dibenz(a,h)anthracene	71	31	Non-parametric	55000	2756	95% KM (Chebyshev)	4727	4727
Fluoranthene	71	66	Lognormal	1600000	36212	95% KM (Chebyshev)	134124	134124
Fluorene	71	40	Lognormal	54000	2795	95% KM (Chebyshev)	5221	5221
Indeno(1,2,3-cd)pyrene	71	60	Lognormal	240000	7992	95% KM (Chebyshev)	21951	21951
Naphthalene	71	44	Approx. Lognormal	230000	11096	95% KM (Chebyshev)	22953	22953
Phenanthrene	71	65	Lognormal	1300000	28320	95% KM (Chebyshev)	107241	107241
Pyrene	71	66	Lognormal	1000000	24696	95% KM (Chebyshev)	85889	85889
Carbazole	71	40	Lognormal	38000	1817	95% KM (Chebyshev)	3421	3421
Dibenzofuran	71	33	Approx. Lognormal	64000	4267	95% KM (Chebyshev)	6805	6805
Benzene	71	33	Approx. Lognormal	440	64.53	95% KM (Chebyshev)	76.6	76.57
N- Nitrosodi-n-propylamine	71	13	Gamma, Lognormal	37000	6473	95% Gamma Approximate KM-UCL	3231	3231

EPC - Exposure Point Concentration

UCL - Upper Confidence Limit of the Mean

* UCL Method Selected in Preferential order of Normal, Gamma, Nonparametric. UCL Method for lognormally distributed data were based on nonparametric value.
95% UCL selected when alternative 97.5 or 99% UCL suggested in ProUCL.

U. S. Steel Fairfield Works
Exum
Upper Impoundment - Exum
Particulate Emission Factor

$$PEF = Q/C * \frac{3{,}600\ sec/hr}{0.036 * (1-v) * \left(\frac{Um}{Ut}\right)^3 * F(x)}$$

$$Q/C = A * exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$$

PEF	A_{site}	Q/C	Um	Ut	V
2.03E+09	7	51.82	2.88	11.32	0.2

Where:

PEF	= Particulate emission factor (kg/m3)
Q/C	= Inverse of the geometric mean air concentration to the emission flux at the center or boundary of the source (g/m^2-sec per kg/m^3)
U_m	= Mean annual wind speed (m/s)
U_t	= Equivalent threshold value of wind speed at 10 m (m/s) = 11.32 (default)
V	= Fraction of vegetative cover (unitless)
F(x)	= Function dependent on U_m/U_t (unitless) = 0.194 (default)
A_{site}	= Areal extent of the site or contamination (acres)
A,B,C	= Constants based on air dispersion modeling for specific climate zones - Values used for Atlanta, GA (Table D-2; USEPA 2002)
A	= 14.8349
B	= 17.9259
C	= 204.1516

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum
Toxicity Values, and Dermal Absorption

RfDd = RfDo * GIABS, only when GIABS < 0.5

Chemical	BAP Equivalency	Toxicity Values: NonCarcinogenic RfD_o (mg/kg-day)	RfD_d (mg/kg-day)	RFCi (mg/m^3)	RfD_i (mg/kg-day)	Carcinogenic: SF_o $(mg/kg\text{-}day)^{-1}$	SF_d $(mg/kg\text{-}day)^{-1}$	IUR $(ug/m3)^{-1}$	SF_i $(mg/kg\text{-}day)^{-1}$	Dermal Absorption (unitless)
Arsenic		3.00E-04	3.00E-04	1.50E-05	4.29E-06	1.50E+00	1.50E+00	4.30E-03	1.51E+01	0.03
Iron		7.00E-01	7.00E-01	--	--	--	--	--	--	0
Manganese		2.40E-02	9.60E-04	5.00E-05	1.43E-05	--	--	--	--	0
Lead		--	--	--	--	--	--	--	--	0
Mercury		3.00E-04	2.10E-05	3.00E-04	8.57E-05	--	--	--	--	0
Zinc		3.00E-01	3.00E-01	--	--	--	--	--	--	0
Cyanide		6.00E-04	6.00E-04	8.00E-04	2.29E-04	--	--	--	--	
Carbazole						2.00E-02	2.00E-02		2.00E-02	0.1
Dibenzofuran		4.00E-03	4.00E-03		4.00E-03					0.1
Benzene		4.00E-03	4.00E-03	3.00E-02	8.57E-03	5.50E-02	5.50E-02	7.80E-06	2.73E-02	
N- Nitrosodi-n-propylamine						7.00E+00	7.00E+00	2.00E-03	7.00E+00	0.1
Acenaphthylene		3.00E-02	3.00E-02	--	--	--	--	--	--	0.13
Benzo(a)anthracene	0.1	--	--	--	--	1.00E-01	1.00E-01	6.00E-05	2.10E-01	0.13
Benzo(a)pyrene	1	3.00E-04	3.00E-04	2.00E-06	5.71E-07	1.00E+00	1.00E+00	6.00E-04	2.10E+00	0.13
Benzo(b)fluoranthene	0.1	--	--	--	--	1.00E-01	1.00E-01	6.00E-05	2.10E-01	0.13
Benzo(k)fluoranthene	0.01	--	--	--	--	1.00E-02	1.00E-02	6.00E-06	2.10E-02	0.13
Chrysene	0.001	--	--	--	--	1.00E-03	1.00E-03	6.00E-07	2.10E-03	0.13
Dibenz(a,h)anthracene	1	--	--	--	--	1.00E+00	1.00E+00	6.00E-04	2.10E+00	0.13
Fluoranthene		4.00E-02	4.00E-02	--	--	--	--	--	--	0.13
Indeno(1,2,3-cd)pyrene	0.1	--	--	--	--	1.00E-01	1.00E-01	6.00E-05	2.10E-01	0.13
Naphthalene		2.00E-02	2.00E-02	3.00E-03	8.57E-04	--	--	3.40E-05	1.19E-01	0.13
Phenanthrene		3.00E-02	3.00E-02	--	--	--	--	--	--	0.13
Pyrene		3.00E-02	3.00E-02	--	--	--	--	--	--	0.13

Notes:
Acenaphthylene, Phenanthrene - Pyrene used as a surrogate
RfD values for cadmium, manganese, mercury, nickel and silver calculated from RfDo using gastrointestinal absorbtion efficient (GIABS) values of 0.05, 0.04, 0.07, 0.04 and 0.04 respectively.

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum
Derivation of Subsurface Soil to Outdoor Air Volatilization Factor (VFsamb)

$$VF_{samb} = \frac{H * \rho_s}{[\theta_{ws} + (K_s * \rho_s) + (H * \theta_{as})] * \left(\frac{U_a * \delta_a * L_s}{D_s^{eff} * W_a}\right)} * 10^3$$

$$D_s^{eff} = D^a * \frac{\theta_{as}^{3.33}}{\theta_T^{2.0}} + D^w * \frac{1}{H} * \frac{\theta_{ws}^{3.33}}{\theta_T^{2.0}}$$

	Vfsamb	D^a	D^w	K_{oc}	f_{oc}	K_s	H	θ_{as}	θ_{ws}	θ_T	ρ_s	W_a	U_a	δ_a	L_s	D_s^{eff}
Benzene	5.20E-03	8.80E-02	9.80E-06	59	0.002	0.118	2.30E-01	0.2	0.1	0.3	1.8	10000	225	200	227	4.60E-03
Naphthalene	2.46E-05	5.90E-02	7.50E-06	1200	0.002	2.4	2.00E-02	0.2	0.1	0.3	1.8	10000	225	200	227	3.09E-03

Where:

Vfsamb = Volatilization Factor from subsurface soil to outdoor air (m^3/kg)
D^a = Diffusion Coefficient in air (chemical-specific; cm^2/s)*
D^w = Diffusion coefficient in water (chemical-specific; cm^2/s)*
H' = Henry's Law constant (L-H20/L-air; chemical-specific)*
θ_{as} =Volumetric air content in vadose zone (cm3-air/cm3-soil)*
θ_{ws} =Volumetric water content in vadose zone (cm3-H20/cm3-soil)*
θ_T = total soil porosity (cm3/cm3-soil) = 0.3*
ρ_s = Dry soil bulk density (g/cm^3)*
K_s = f_{oc} *K_{oc} ; Soil-water partition coefficient (chemical-specific; cm^3-H20/g-soil)
K_{oc} = Soil-organic carbon partition coefficient (chemical-specific; cm^3/g)*
f_{oc} = Fraction organic carbon (g/g). The ARBCA (2008) default of 0.002 was used.
W_a = Length of soil source area parallel to wind direction (cm)
U_a = Wind speed at δ_a above ground surface (cm/s)*
δ_a = Breathing zone height (cm)*
L_s = Depth to subsurface soil sources (cm) (assumed 1/2 total exposure depth of 15 ft; 227 cm)
D_s^{eff} = Effective diffusion coefficient in soil based on vapor-phase concentration (cm2/s)

* Values obtained from ARBCA (2008), except o-Xylene and m,p Xylenes from USEPA RSL Tables (Nov 2017)

Length of soil source area assumed to be 100 m (10000 cm)

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum
Industrial Worker Scenario

Industrial Worker Scenario

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o} \qquad CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 75
EF = Exposure Frequency (days/yr) = 198
ED = Exposure Duration (years) = 25
CF1 = Conversion Factor (kg/mg) = 1.00E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 70
AT_{nc} = Averaging Time Non-cancer (days) = 9125
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	99.3	75	0.6	198	25	1E-06	70	9125	25550	3.0E-04	1.2E-01	1.5E+00	1.9E-05
Iron	286507	75	1	198	25	1E-06	70	9125	25550	7.0E-01	2.4E-01	--	--
Manganese	9149	75	1	198	25	1E-06	70	9125	25550	2.4E-02	2.2E-01	--	--
Mercury	3.00	75	1	198	25	1E-06	70	9125	25550	3.0E-04	5.8E-03	--	--
Nickel	843.2	75	1	198	25	1E-06	70	9125	25550	2.0E-02	2.5E-02	--	--
Zinc	5536	75	1	198	25	1E-06	70	9125	25550	0.3	1.1E-02	--	--
Cyanide	2.7	75	1	198	25	1E-06	70	9125	25550	0.0006	2.6E-03	--	--
Benzene	0.17580	75	1	198	25	1E-06	70	9125	25550	0.004	2.6E-05	5.5E-02	2.0E-09
N- Nitrosodi-n-propylamine	5.86	75	1	198	25	1E-06	70	9125	25550	--	--	7.0E+00	8.5E-06
2-Methylnaphthalene	7.5	75	1	198	25	1E-06	70	9125	25550	4.0E-03	1.1E-03	--	--
Acenaphthylene	28	75	1	198	25	1E-06	70	9125	25550	3.0E-02	5.4E-04	--	--
Benzo(a)anthracene	127	75	1	198	25	1E-06	70	9125	25550	--	--	1.0E-01	2.6E-06
Benzo(a)pyrene	81	75	1	198	25	1E-06	70	9125	25550	3.0E-04	1.6E-01	1.0E+00	1.7E-05
Benzo(b)fluoranthene	137	75	1	198	25	1E-06	70	9125	25550	--	--	1.0E-01	2.8E-06
Benzo(k)fluoranthene	47	75	1	198	25	1E-06	70	9125	25550	--	--	1.0E-02	9.7E-08
Carbazole	10	75	1	198	25	1E-06	70	9125	25550	--	--	2.0E-02	4.1E-08
Chrysene	112	75	1	198	25	1E-06	70	9125	25550	--	--	1.0E-03	2.3E-08
Dibenz(a,h)anthracene	14.3	75	1	198	25	1E-06	70	9125	25550	--	--	1.0E+00	3.0E-06
Dibenzofuran	20.3	75	1	198	25	1E-06	70	9125	25550	4.0E-03	2.9E-03	--	--
Fluoranthene	403	75	1	198	25	1E-06	70	9125	25550	4.0E-02	5.9E-03	--	--
Fluorene	16	75	1	198	25	1E-06	70	9125	25550	4.0E-02	2.3E-04	--	--
Indeno(1,2,3-cd)pyrene	63	75	1	198	25	1E-06	70	9125	25550	--	--	1.0E-01	1.3E-06
Naphthalene	67	75	1	198	25	1E-06	70	9125	25550	2.0E-02	2.0E-03	--	--
Phenanthrene	324	75	1	198	25	1E-06	70	9125	25550	3.0E-02	6.3E-03	--	--
Pyrene	255	75	1	198	25	1E-06	70	9125	25550	3.0E-02	4.9E-03	--	--
										Total HI =	8.0E-01	Total CR =	5.4E-05

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d} \qquad CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 1930 RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific

M = Dermal Adherence Rate (mg/cm^2) = 0.2 SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	99.3	1930	0.2	0.03	198	25	1E-06	70	9125	25550	3.0E-04	3.0E-02	1.5E+00	4.8E-06
Iron	286507	1930	0.2	0	198	25	1E-06	70	9125	25550	7.0E-01	0.0E+00	--	--
Manganese	9149	1930	0.2	0	198	25	1E-06	70	9125	25550	9.6E-04	0.0E+00	--	--
Mercury	3.00	1930	0.2	0	198	25	1E-06	70	9125	25550	2.1E-05	0.0E+00	--	--
Nickel	843.2	1930	0.2	0	198	25	1E-06	70	9125	25550	8.0E-04	0.0E+00	--	--
Zinc	5536	1930	0.2	0	198	25	1E-06	70	9125	25550	0.3	0.0E+00	--	--
Cyanide	2.71	1930	0.2	0	198	25	1E-06	70	9125	25550	0.0006	0.0E+00	--	--
N- Nitrosodi-n-propylamine	6	1930	0.2	0.1	198	25	1E-06	70	9125	25550	--	--	7.0E+00	4.4E-06
2-Methylnaphthalene	7	1930	0.2	0.13	198	25	1E-06	70	9125	25550	4.0E-03	7.3E-04	--	--
Acenaphthylene	28	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-02	3.6E-04	--	--
Benzo(a)anthracene	127	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-01	1.8E-06
Benzo(a)pyrene	81	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-04	1.1E-01	1.0E+00	1.1E-05
Benzo(b)fluoranthene	137	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-01	1.9E-06
Benzo(ghi)perylene	0	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-02	0.0E+00	--	--
Benzo(k)fluoranthene	47	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-02	6.5E-08
Carbazole	10	1930	1.2	0.1	198	25	1E-06	70	9125	25550	--	--	2.0E-02	1.3E-07
Chrysene	112	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-03	1.6E-08
Dibenz(a,h)anthracene	14	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E+00	2.0E-06
Dibenzofuran	20	1930	2.2	0.1	198	25	1E-06	70	9125	25550	4.0E-03	1.7E-02	--	--
Fluoranthene	403	1930	0.2	0.13	198	25	1E-06	70	9125	25550	4.0E-02	3.9E-03	--	--
Fluorene	16	1930	0.2	0.13	198	25	1E-06	70	9125	25550	4.0E-02	1.6E-04	--	--
Indeno(1,2,3-cd)pyrene	63	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-01	8.8E-07
Naphthalene	67	1930	0.2	0.13	198	25	1E-06	70	9125	25550	2.0E-02	1.3E-03	--	--
Phenanthrene	324	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-02	4.2E-03	--	--
Pyrene	255	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-02	3.3E-03	--	--
												Total HI = 1.7E-01		Total CR = 2.7E-05

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1.5
ET = Exposure Time (hrs/day) = 8
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 12
PEF - Particulate Emission Factor (m3/kg) = 2.03E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	99.3	198	25	70	12	2.03E+09	9125	25550	4.29E-06	1.1E-03	1.5E+01	2.4E-08
Iron	286507	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Manganese	9149	198	25	70	12	2.03E+09	9125	25550	1.43E-05	2.9E-02	--	--
Mercury	3.00	198	25	70	12	2.03E+09	9125	25550	8.57E-05	1.6E-06	--	--
Nickel	843.2	198	25	70	12	2.03E+09	9125	25550	2.57E-05	1.5E-03	9.1E-01	1.3E-08
Zinc	5536	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Cyanide	2.71	198	25	70	12	2.03E+09	9125	25550	2.29E-04	5.4E-07	--	--
Benzene	0.18	198	25	70	12	2.03E+09	9125	25550	8.57E-03	9.4E-10	2.7E-02	7.9E-14
N- Nitrosodi-n-propylamine	6	198	25	70	12	2.03E+09	9125	25550	--	--	7.0E+00	6.7E-10
2-Methylnaphthalene	7	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Acenaphthylene	28	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Benzo(a)anthracene	127	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-01	4.4E-10
Benzo(a)pyrene	81	198	25	70	12	2.03E+09	9125	25550	5.71E-07	6.5E-03	2.1E+00	2.8E-09
Benzo(b)fluoranthene	137	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-01	4.7E-10
Benzo(ghi)perylene	0	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Benzo(k)fluoranthene	47	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-02	1.6E-11
Carbazole	10	198	25	70	12	2.03E+09	9125	25550	--	--	2.0E-02	3.2E-12
Chrysene	112	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-03	3.8E-12
Dibenz(a,h)anthracene	14	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E+00	4.9E-10
Dibenzofuran	20	198	25	70	12	2.03E+09	9125	25550	4.00E-03	2.3E-07	--	--
Fluoranthene	403	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Fluorene	16	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Indeno(1,2,3-cd)pyrene	63	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-01	2.2E-10
Naphthalene	67	198	25	70	12	2.03E+09	9125	25550	8.57E-04	3.6E-06	1.2E-01	1.3E-10
Phenanthrene	324	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Pyrene	255	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
									Total HI =	3.8E-02	Total CR =	4.2E-08

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao}}{VF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{VF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1.5
ET = Exposure Time (hrs/day) = 8
IR_{ao} - Daily outdoor inhalation rate (m^3/day) = 12
VF - Volatilization Factor (m3/kg) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Benzene	0.18	198	25	70	12	3.81E+03	9125	25550	8.57E-03	5.0E-04	0.0273	4.2E-08
Naphthalene	67	198	25	70	12	4.99E+04	9125	25550	8.57E-04	1.5E-01	0.119	5.3E-06
									Total HI =	1.5E-01	Total CR =	5.4E-06

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Construction Worker Scenario

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o} \qquad CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 177
EF = Exposure Frequency (days/yr) = 195
ED = Exposure Duration (years) = 1
CF1 = Conversion Factor (kg/mg) = 1.00E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 70
AT_{nc} = Averaging Time Non-cancer (days) = 365
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	69.55	177	0.6	195	1	1E-06	70	365	25550	3.0E-04	1.9E-01	1.5E+00	1.2E-06
Iron	296437	177	1	195	1	1E-06	70	365	25550	7.0E-01	5.7E-01	--	--
Manganese	9722	177	1	195	1	1E-06	70	365	25550	2.4E-02	5.5E-01	--	--
Mercury	1.10	177	1	195	1	1E-06	70	365	25550	3.0E-04	5.0E-03	--	--
Nickel	1078	177	1	195	1	1E-06	70	365	25550	2.0E-02	7.3E-02	--	--
Zinc	9361	177	1	195	1	1E-06	70	365	25550	0.3	4.2E-02	--	--
Cyanide	2.4	177	1	195	1	1E-06	70	365	25550	0.0006	5.4E-03	--	--
Benzene	0.1	177	1	195	1	1E-06	70	365	25550	4.0E-03	2.6E-05	5.5E-02	8.1E-11
N- Nitrosodi-n-propylamine	3	177	1	195	1	1E-06	70	365	25550	--	--	7.0E+00	4.4E-07
2-Methylnaphthalene	3	177	1	195	1	1E-06	70	365	25550	4.0E-03	1.0E-03	--	--
Acenaphthylene	10	177	1	195	1	1E-06	70	365	25550	3.0E-02	4.3E-04	--	--
Benzo(a)anthracene	42	177	1	195	1	1E-06	70	365	25550	--	--	1.0E-01	8.2E-08
Benzo(a)pyrene	28	177	1	195	1	1E-06	70	365	25550	3.0E-04	1.3E-01	1.0E+00	5.4E-07
Benzo(b)fluoranthene	47	177	1	195	1	1E-06	70	365	25550	--	--	1.0E-01	9.1E-08
Benzo(ghi)perylene	NA	177	1	195	1	1E-06	70	365	25550	3.0E-02	--	--	--
Benzo(k)fluoranthene	16	177	1	195	1	1E-06	70	365	25550	--	--	1.0E-02	3.1E-09
Carbazole	3	177	1	195	1	1E-06	70	365	25550	--	--	2.0E-02	1.3E-09
Chrysene	38	177	1	195	1	1E-06	70	365	25550	--	--	1.0E-03	7.3E-10
Dibenz(a,h)anthracene	4.7	177	1	195	1	1E-06	70	365	25550	--	--	1.0E+00	9.1E-08
Dibenzofuran	7	177	1	195	1	1E-06	70	365	25550	4.0E-03	2.3E-03	--	--
Fluoranthene	134	177	1	195	1	1E-06	70	365	25550	4.0E-02	4.5E-03	--	--
Fluorene	5	177	1	195	1	1E-06	70	365	25550	4.0E-02	1.8E-04	--	--
Indeno(1,2,3-cd)pyrene	22	177	1	195	1	1E-06	70	365	25550	--	--	1.0E-01	4.2E-08
Naphthalene	23	177	1	195	1	1E-06	70	365	25550	2.0E-02	1.6E-03	--	--
Phenanthrene	107	177	1	195	1	1E-06	70	365	25550	3.0E-02	4.8E-03	--	--
Pyrene	86	177	1	195	1	1E-06	70	365	25550	3.0E-02	3.9E-03	--	--
											Total HI =	1.6E+00	Total CR = 2.5E-06

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d} \qquad CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 1930 | RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific

M = Dermal Adherence Rate (mg/cm^2) = 0.2 | SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	69.6	1930	0.2	0.03	195	1	1E-06	70	365	25550	3.0E-04	2.0E-02	1.5E+00	1.3E-07
Iron	296437	1930	0.2	0	195	1	1E-06	70	365	25550	7.0E-01	0.0E+00	--	--
Manganese	9722	1930	0.2	0	195	1	1E-06	70	365	25550	9.6E-04	0.0E+00	--	--
Mercury	1.10	1930	0.2	0	195	1	1E-06	70	365	25550	2.1E-05	0.0E+00	--	--
Nickel	1078	1930	0.2	0	195	1	1E-06	70	365	25550	8.0E-04	0.0E+00	--	--
Zinc	9361	1930	0.2	0	195	1	1E-06	70	365	25550	0.3	0.0E+00	--	--
Cyanide	2.4	1930	0.2	0	195	1	1E-06	70	365	25550	0.0006	0.0E+00	--	--
N- Nitrosodi-n-propylamine	3	1930	0.2	0.1	195	1	1E-06	70	365	25550	--	--	7.0E+00	9.5E-08
2-Methylnaphthalene	3	1930	0.2	0.13	195	1	1E-06	70	365	25550	4.0E-03	2.8E-04	--	--
Acenaphthylene	10	1930	0.2	0.13	195	1	1E-06	70	365	25550	3.0E-02	1.2E-04	--	--
Benzo(a)anthracene	42	1930	0.2	0.13	195	1	1E-06	70	365	25550	--	--	1.0E-01	2.3E-08
Benzo(a)pyrene	28	1930	0.2	0.13	195	1	1E-06	70	365	25550	3.0E-04	3.6E-02	1.0E+00	1.5E-07
Benzo(b)fluoranthene	47	1930	0.2	0.13	195	1	1E-06	70	365	25550	--	--	1.0E-01	2.6E-08
Benzo(ghi)perylene	NA	1930	0.2	0.13	195	1	1E-06	70	365	25550	3.0E-02	--	--	--
Benzo(k)fluoranthene	16	1930	0.2	0.13	195	1	1E-06	70	365	25550	--	--	1.0E-02	8.7E-10
Carbazole	3	1930	0.2	0.1	195	1	1E-06	70	365	25550	--	--	2.0E-02	2.9E-10
Chrysene	38	1930	0.2	0.13	195	1	1E-06	70	365	25550	--	--	1.0E-03	2.1E-10
Dibenz(a,h)anthracene	4.7	1930	0.2	0.13	195	1	1E-06	70	365	25550	--	--	1.0E+00	2.6E-08
Dibenzofuran	7	1930	0.2	0.1	195	1	1E-06	70	365	25550	4.0E-03	5.0E-04	--	--
Fluoranthene	134	1930	0.2	0.13	195	1	1E-06	70	365	25550	4.0E-02	1.3E-03	--	--
Fluorene	5	1930	0.2	0.13	195	1	1E-06	70	365	25550	4.0E-02	5.0E-05	--	--
Indeno(1,2,3-cd)pyrene	22	1930	0.2	0.13	195	1	1E-06	70	365	25550	--	--	1.0E-01	1.2E-08
Naphthalene	23	1930	0.2	0.13	195	1	1E-06	70	365	25550	2.0E-02	4.4E-04	--	--
Phenanthrene	107	1930	0.2	0.13	195	1	1E-06	70	365	25550	3.0E-02	1.4E-03	--	--
Pyrene	86	1930	0.2	0.13	195	1	1E-06	70	365	25550	3.0E-02	1.1E-03	--	--
											Total HI =	6.1E-02	Total CR =	4.7E-07

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1.5
ET = Exposure Time (hrs/day) = 8
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 12
PEF - Particulate Emission Factor (m3/kg) = 2.03E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	69.6	195	1	70	12	2.03E+09	365	25550	4.29E-06	7.3E-04	1.5E+01	6.8E-10
Iron	296437	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Manganese	9722	195	1	70	12	2.03E+09	365	25550	1.43E-05	3.1E-02	--	--
Mercury	1.10	195	1	70	12	2.03E+09	365	25550	8.57E-05	5.8E-07	--	--
Nickel	1078	195	1	70	12	2.03E+09	365	25550	2.57E-05	1.9E-03	9.1E-01	6.3E-10
Zinc	9361	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Cyanide	2.4	195	1	70	12	2.03E+09	365	25550	2.29E-04	4.7E-07	--	--
Benzene	0.1	195	1	70	12	2.03E+09	365	25550	8.57E-03	4.0E-10	2.7E-02	1.3E-15
N- Nitrosodi-n-propylamine	3	195	1	70	12	2.03E+09	365	25550	--	--	7.0E+00	1.5E-11
2-Methylnaphthalene	3	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Acenaphthylene	10	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Benzo(a)anthracene	42	195	1	70	12	2.03E+09	365	25550	--	--	2.1E-01	5.7E-12
Benzo(a)pyrene	28	195	1	70	12	2.03E+09	365	25550	5.71E-07	2.2E-03	2.1E+00	3.8E-11
Benzo(b)fluoranthene	47	195	1	70	12	2.03E+09	365	25550	--	--	2.1E-01	6.4E-12
Benzo(ghi)perylene	NA	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Benzo(k)fluoranthene	16	195	1	70	12	2.03E+09	365	25550	--	--	2.1E-02	2.2E-13
Carbazole	3	195	1	70	12	2.03E+09	365	25550	--	--	2.0E-02	4.4E-14
Chrysene	38	195	1	70	12	2.03E+09	365	25550	--	--	2.1E-03	5.2E-14
Dibenz(a,h)anthracene	4.7	195	1	70	12	2.03E+09	365	25550	--	--	2.1E+00	6.4E-12
Dibenzofuran	7	195	1	70	12	2.03E+09	365	25550	4.00E-03	7.7E-08	--	--
Fluoranthene	134	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Fluorene	5	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Indeno(1,2,3-cd)pyrene	22	195	1	70	12	2.03E+09	365	25550	--	--	2.1E-01	3.0E-12
Naphthalene	23	195	1	70	12	2.03E+09	365	25550	8.57E-04	1.2E-06	1.2E-01	1.8E-12
Phenanthrene	107	195	1	70	12	2.03E+09	365	25550	--	--	--	--
Pyrene	86	195	1	70	12	2.03E+09	365	25550	--	--	--	--
									Total HI =	3.6E-02	Total CR =	1.4E-09

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao} * VF_{samb}}{BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i * VF_{samb}}{BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1.5
ET = Exposure Time (hrs/day) = 8
IR_{ao} - Daily outdoor inhalation rate (m^3/day) = 12
VFsamb - Subsurface Soil Volatilization Factor (mg/m3-air/mg/kg-soil) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VFsamb (mg/m3-air/mg/kg-soil)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Benzene	0.08	195	1	70	12	5.20E-03	365	25550	8.57E-03	4.3E-03	2.73E-02	1.4E-08
Naphthalene	23	195	1	70	12	2.46E-05	365	25550	8.57E-04	6.0E-02	1.19E-01	8.8E-08
									Total HI =	6.5E-02	Total CR =	1.0E-07

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Maintenance Worker Scenario

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o}$$

$$CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 177
EF = Exposure Frequency (days/yr) = 198
ED = Exposure Duration (years) = 25
CF1 = Conversion Factor (kg/mg) = 1.00E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 70
AT_{nc} = Averaging Time Non-cancer (days) = 9125
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor (mg/kg-day)$^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	69.6	177	0.6	198	25	1E-06	70	9125	25550	3.0E-04	1.9E-01	1.5E+00	3.1E-05
Iron	296437	177	1	198	25	1E-06	70	9125	25550	7.0E-01	5.8E-01	--	--
Manganese	9722	177	1	198	25	1E-06	70	9125	25550	2.4E-02	5.6E-01	--	--
Mercury	1.10	177	1	198	25	1E-06	70	9125	25550	3.0E-04	5.0E-03	--	--
Nickel	1078	177	1	198	25	1E-06	70	9125	25550	2.0E-02	7.4E-02	--	--
Zinc	9361	177	1	198	25	1E-06	70	9125	25550	0.3	4.3E-02	--	--
Cyanide	2.38	177	1	198	25	1E-06	70	9125	25550	0.0006	5.4E-03	--	--
Benzene	0.1	177	1	198	25	1E-06	70	9125	25550	4.0E-03	2.6E-05	5.5E-02	2.1E-09
N- Nitrosodi-n-propylamine	3	177	1	198	25	1E-06	70	9125	25550	--	--	7.0E+00	1.1E-05
2-Methylnaphthalene	3	177	1	198	25	1E-06	70	9125	25550	4.0E-03	1.0E-03	--	--
Acenaphthylene	10	177	1	198	25	1E-06	70	9125	25550	3.0E-02	4.3E-04	--	--
Benzo(a)anthracene	42	177	1	198	25	1E-06	70	9125	25550	--	--	1.0E-01	2.1E-06
Benzo(a)pyrene	28	177	1	198	25	1E-06	70	9125	25550	3.0E-04	1.3E-01	1.0E+00	1.4E-05
Benzo(b)fluoranthene	47	177	1	198	25	1E-06	70	9125	25550	--	--	1.0E-01	2.3E-06
Benzo(ghi)perylene	NA	177	1	198	25	1E-06	70	9125	25550	3.0E-02	--	--	--
Benzo(k)fluoranthene	16	177	1	198	25	1E-06	70	9125	25550	--	--	1.0E-02	7.8E-08
Carbazole	3	177	1	198	25	1E-06	70	9125	25550	--	--	2.0E-02	3.4E-08
Chrysene	38	177	1	198	25	1E-06	70	9125	25550	--	--	1.0E-03	1.9E-08
Dibenz(a,h)anthracene	4.7	177	1	198	25	1E-06	70	9125	25550	--	--	1.0E+00	2.3E-06
Fluoranthene	134	177	1	198	25	1E-06	70	9125	25550	4.0E-02	4.6E-03	--	--
Fluorene	5	177	1	198	25	1E-06	70	9125	25550	4.0E-02	1.8E-04	--	--
Indeno(1,2,3-cd)pyrene	22	177	1	198	25	1E-06	70	9125	25550	--	--	1.0E-01	1.1E-06
Dibenzofuran	7	177	1	198	25	1E-06	70	9125	25550	4.0E-03	2.3E-03	--	--
Naphthalene	23	177	1	198	25	1E-06	70	9125	25550	2.0E-02	1.6E-03	--	--
Phenanthrene	107	177	1	198	25	1E-06	70	9125	25550	3.0E-02	4.9E-03	--	--
Pyrene	86	177	1	198	25	1E-06	70	9125	25550	3.0E-02	3.9E-03	--	--
											Total HI = 1.6E+00	Total CR =	6.3E-05

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d}$$

$$CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 1930

M = Dermal Adherence Rate (mg/cm^2) = 0.2

RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific

RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific

SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	69.6	1930	0.2	0.03	198	25	1E-06	70	9125	25550	3.0E-04	2.1E-02	1.5E+00	3.3E-06
Iron	296437	1930	0.2	0	198	25	1E-06	70	9125	25550	7.0E-01	0.0E+00	--	--
Manganese	9722	1930	0.2	0	198	25	1E-06	70	9125	25550	9.6E-04	0.0E+00	--	--
Mercury	1.10	1930	0.2	0	198	25	1E-06	70	9125	25550	2.1E-05	0.0E+00	--	--
Nickel	1078	1930	0.2	0	198	25	1E-06	70	9125	25550	8.0E-04	0.0E+00	--	--
Zinc	9361	1930	0.2	0	198	25	1E-06	70	9125	25550	3.0E-01	0.0E+00	--	--
Cyanide	2.38	1930	0.2	0	198	25	1E-06	70	9125	25550	6.0E-04	0.0E+00	--	--
N- Nitrosodi-n-propylamine	3	1930	0.2	0.1	198	25	1E-06	70	9125	25550	--	--	7.0E+00	2.4E-06
2-Methylnaphthalene	3	1930	0.2	0.13	198	25	1E-06	70	9125	25550	4.0E-03	2.9E-04	--	--
Benzo(a)anthracene	42	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-01	5.9E-07
Benzo(a)pyrene	28	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-04	3.6E-02	1.0E+00	3.9E-06
Benzo(b)fluoranthene	47	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-01	6.5E-07
Benzo(k)fluoranthene	16	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-02	2.2E-08
Carbazole	3	1930	0.2	0.1	198	25	1E-06	70	9125	25550	--	--	2.0E-02	7.3E-09
Chrysene	38	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-03	5.3E-09
Dibenz(a,h)anthracene	4.7	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E+00	6.6E-07
Fluoranthene	134	1930	0.2	0.13	198	25	1E-06	70	9125	25550	4.0E-02	1.3E-03	--	--
Fluorene	5	1930	0.2	0.13	198	25	1E-06	70	9125	25550	4.0E-02	5.1E-05	--	--
Indeno(1,2,3-cd)pyrene	22	1930	0.2	0.13	198	25	1E-06	70	9125	25550	--	--	1.0E-01	3.0E-07
Dibenzofuran	7	1930	0.2	0.1	198	25	1E-06	70	9125	25550	4.0E-03	5.1E-04	--	--
Naphthalene	23	1930	0.2	0.13	198	25	1E-06	70	9125	25550	2.0E-02	4.5E-04	--	--
Phenanthrene	107	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-02	1.4E-03	--	--
Pyrene	86	1930	0.2	0.13	198	25	1E-06	70	9125	25550	3.0E-02	1.1E-03	--	--
											Total HI =	6.2E-02	Total CR =	1.2E-05

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1.5
ET = Exposure Time (hrs/day) = 8
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 12
PEF - Particulate Emission Factor (m3/kg) = 2.03E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	69.6	198	25	70	12	2.03E+09	9125	25550	4.29E-06	7.4E-04	1.5E+01	1.7E-08
Iron	296437	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Manganese	9722	198	25	70	12	2.03E+09	9125	25550	1.43E-05	3.1E-02	--	--
Mercury	1.10	198	25	70	12	2.03E+09	9125	25550	8.57E-05	5.9E-07	--	--
Nickel	1078	198	25	70	12	2.03E+09	9125	25550	2.57E-05	1.9E-03	9.1E-01	1.6E-08
Zinc	9361	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Cyanide	2.38	198	25	70	12	2.03E+09	9125	25550	2.29E-04	4.8E-07	--	--
Benzene	0.08	198	25	70	12	2.03E+09	9125	25550	8.57E-03	4.1E-10	2.7E-02	3.4E-14
N- Nitrosodi-n-propylamine	3	198	25	70	12	2.03E+09	9125	25550	--	--	7.0E+00	3.7E-10
2-Methylnaphthalene	3	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Acenaphthylene	10	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Benzo(a)anthracene	42	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-01	1.5E-10
Benzo(a)pyrene	28	198	25	70	12	2.03E+09	9125	25550	5.71E-07	2.2E-03	2.1E+00	9.6E-10
Benzo(b)fluoranthene	47	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-01	1.6E-10
Benzo(k)fluoranthene	16	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-02	5.5E-12
Carbazole	3	198	25	70	12	2.03E+09	9125	25550	--	--	2.0E-02	1.1E-12
Chrysene	38	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-03	1.3E-12
Dibenz(a,h)anthracene	4.7	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E+00	1.6E-10
Fluoranthene	134	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Fluorene	5	198	25	70	12	2.03E+09	9125	25550	--	--	--	--
Indeno(1,2,3-cd)pyrene	22	198	25	70	12	2.03E+09	9125	25550	--	--	2.1E-01	7.6E-11
Dibenzofuran	7	198	25	70	12	2.03E+09	9125	25550	4.00E-03	7.8E-08	--	--
Naphthalene	23	198	25	70	12	2.03E+09	9125	25550	8.57E-04	1.2E-06	1.2E-01	4.5E-11
Phenanthrene	107	198	25	70	12	2027615926	9125	25550	--	--	--	--
Pyrene	86	198	25	70	12	2027615926	9125	25550	--	--	--	--
									Total HI =	3.6E-02	Total CR =	3.5E-08

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao} * VF_{samb}}{BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i * VF_{samb}}{BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1.5
ET = Exposure Time (hrs/day) = 8
IR_{ao} - Daily outdoor inhalation rate (m^3/day) = 12
VFsamb - Subsurface Soil Volatilization Factor (mg/m3-air/mg/kg-soil) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VFsamb (mg/m3-air/mg/kg-soil)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Benzene	0.08	198	25	70	12	5.20E-03	9125	25550	8.57E-03	4.3E-03	0.0273	3.6E-07
Naphthalene	23	198	25	70	12	2.46E-05	9125	25550	8.57E-04	6.1E-02	0.119	2.2E-06
									Total HI =	6.6E-02	Total CR =	2.6E-06

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Trespasser Scenario - Exum Upper Impoundment

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o}$$

$$CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 50
EF = Exposure Frequency (days/yr) = 52
ED = Exposure Duration (years) = 12
CF1 = Conversion Factor (kg/mg) = 1E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 47
AT_{nc} = Averaging Time Non-cancer (days) = 4380
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor (mg/kg-day)$^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	99.3	50	0.6	52	12	1E-06	47	4380	25550	3.0E-04	3.0E-02	1.5E+00	2.3E-06
Iron	286507	50	1	52	12	1E-06	47	4380	25550	7.0E-01	6.2E-02	--	--
Manganese	9149	50	1	52	12	1E-06	47	4380	25550	2.4E-02	5.8E-02	--	--
Mercury	2.996	50	1	52	12	1E-06	47	4380	25550	3.0E-04	1.5E-03	--	--
Cyanide	2.7	50	1	52	12	1E-06	47	4380	25550	0.0006	6.8E-04	--	--
Benzene	0.17580	50	1	52	12	1E-06	47	4380	25550	0.004	6.7E-06	0.055	2.5E-10
Ethyl Benzene	0.00000	50	1	52	12	1E-06	47	4380	25550	0.1	0.0E+00	0.011	0.0E+00
m-Xylene & p-Xylene	0.0000	50	1	52	12	1E-06	47	4380	25550	0.2	0.0E+00	--	--
2-Methylnaphthalene	7.5	50	1	52	12	1E-06	47	4380	25550	4.0E-03	2.8E-04	--	--
Benzo(a)anthracene	127	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	3.3E-07
Benzo(a)pyrene	81	50	1	52	12	1E-06	47	4380	25550	3.0E-04	4.1E-02	1.0E+00	2.1E-06
Benzo(b)fluoranthene	137	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	3.6E-07
Benzo(ghi)perylene	0	50	1	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
Benzo(k)fluoranthene	46.6	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-02	1.2E-08
Carbazole	9.8	50	1	52	12	1E-06	47	4380	25550	--	--	2.0E-02	5.1E-09
Chrysene	112	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-03	2.9E-09
Dibenz(a,h)anthracene	14.3	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E+00	3.7E-07
Fluoranthene	403	50	1	52	12	1E-06	47	4380	25550	4.0E-02	1.5E-03	--	--
Fluorene	16.0	50	1	52	12	1E-06	47	4380	25550	4.0E-02	6.1E-05	--	--
Indeno(1,2,3-cd)pyrene	63	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	1.6E-07
Dibenzofuran	20.3	50	1	52	12	1E-06	47	4380	25550	4.0E-03	7.7E-04	--	--
Naphthalene	67.1	50	1	52	12	1E-06	47	4380	25550	2.0E-02	5.1E-04	--	--
Phenanthrene	324	50	1	52	12	1E-06	47	4380	25550	3.0E-02	1.6E-03	--	--
Pyrene	255	50	1	52	12	1E-06	47	4380	25550	3.0E-02	1.3E-03	--	--
											Total HI =	Total CR =	
											2.1E-01	5.7E-06	

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Trespasser Scenario - Exum Upper Impoundment

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d}$$

$$CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 3677
M = Dermal Adherence Rate (mg/cm^2) = 0.02
RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific
RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific
SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	99.3	3677	0.2	0.03	52	12	1E-06	47	4380	25550	3.0E-04	2.2E-02	1.5E+00	1.7E-06
Iron	286507	3677	0.2	0	52	12	1E-06	47	4380	25550	7.0E-01	0.0E+00	--	--
Manganese	9149	3677	0.2	0	52	12	1E-06	47	4380	25550	9.6E-04	0.0E+00	--	--
Mercury	3.00	3677	0.2	0	52	12	1E-06	47	4380	25550	2.1E-05	0.0E+00	--	--
Cyanide	2.7	3677	0.2	0	52	12	1E-06	47	4380	25550	0.0006	0.0E+00	--	--
2-Methylnaphthalene	7.5	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-03	5.4E-04	--	--
Benzo(a)anthracene	127	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	6.3E-07
Benzo(a)pyrene	81	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-04	7.9E-02	1.0E+00	4.0E-06
Benzo(b)fluoranthene	137	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	6.8E-07
Benzo(ghi)perylene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
Benzo(k)fluoranthene	46.6	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-02	2.3E-08
Carbazole	10	3677	1.2	0.1	52	12	1E-06	47	4380	25550	--	--	2.0E-02	4.5E-08
Chrysene	112	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-03	5.5E-09
Dibenz(a,h)anthracene	14.3	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E+00	7.1E-07
Fluoranthene	403	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-02	2.9E-03	--	--
Fluorene	16.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-02	1.2E-04	--	--
Indeno(1,2,3-cd)pyrene	63	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	3.1E-07
Dibenzofuran	20.3	3677	1.2	0.1	52	12	1E-06	47	4380	25550	4.0E-03	6.8E-03	--	--
Naphthalene	67	3677	0.2	0.13	52	12	1E-06	47	4380	25550	2.0E-02	9.7E-04	--	--
Phenanthrene	324	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	3.1E-03	--	--
Pyrene	255	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	2.5E-03	--	--
												Total HI =	1.2E-01	Total CR = 8.2E-06

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Trespasser Scenario - Exum Upper Impoundment

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
PEF - Particulate Emission Factor (m3/kg) = 2.03E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	99.3	52	12	47	2	2.03E+09	4380	25550	4.29E-06	6.9E-05	1.5E+01	7.7E-10
Iron	286507	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Manganese	9149	52	12	47	2	2.03E+09	4380	25550	1.43E-05	1.9E-03	--	--
Mercury	3.00	52	12	47	2	2.03E+09	4380	25550	8.57E-05	1.0E-07	--	--
Cyanide	2.7	52	12	47	2	2.03E+09	4380	25550	2.29E-04	3.5E-08	--	--
Benzene	0.17580	52	12	47	2	2.03E+09	4380	25550	8.57E-03	6.1E-11	0.0273	2.5E-15
Ethyl Benzene	0.00000	52	12	47	2	2.03E+09	4380	25550	2.86E-01	0.0E+00	0.00875	0.0E+00
m-Xylene & p-Xylene	0.0000	52	12	47	2	2.03E+09	4380	25550	2.86E-02	0.0E+00	--	--
2-Methylnaphthalene	7.5	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Benzo(a)anthracene	127	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-01	1.4E-11
Benzo(a)pyrene	81	52	12	47	2	2.03E+09	4380	25550	5.71E-07	4.3E-04	2.1E+00	8.8E-11
Benzo(b)fluoranthene	137	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-01	1.5E-11
Benzo(ghi)perylene	0	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Benzo(k)fluoranthene	46.6	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-02	5.0E-13
Carbazole	10	52	12	47	2	2.03E+09	4380	25550	--	--	2.0E-02	1.0E-13
Chrysene	112	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-03	1.2E-13
Dibenz(a,h)anthracene	14.3	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E+00	1.5E-11
Fluoranthene	403	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Fluorene	16.0	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Indeno(1,2,3-cd)pyrene	63	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-01	6.8E-12
Dibenzofuran	20.3	52	12	47	2	2.03E+09	4380	25550	4.00E-03	1.5E-08	--	--
Naphthalene	67	52	12	47	2	2.03E+09	4380	25550	8.57E-04	2.3E-07	1.2E-01	4.1E-12
Phenanthrene	324	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Pyrene	255	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
									Total HI =	2.5E-03	Total CR =	1.3E-09

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao}}{VF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{VF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
VF - Volatilization Factor (m3/kg) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Trespasser Scenario - Exum Upper Impoundment

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Benzene	0.176	52	12	47	2	3.81E+03	4380	25550	8.57E-03	3.3E-05	0.0273	1.3E-09
Ethyl Benzene	0.000	52	12	47	2	6.10E+03	4380	25550	2.86E-01	0.0E+00	0.00875	0.0E+00
m-Xylene & p-Xylene	0.000	52	12	47	2	6.01E+03	4380	25550	2.86E-02	0.0E+00	--	--
Naphthalene	67.1	52	12	47	2	4.99E+04	4380	25550	8.57E-04	9.5E-03	0.119	1.7E-07
									Total HI =	9.5E-03	Total CR =	1.7E-07

APPENDIX C

HUMANY HEALTH RISK ASSESSMENT - TRESPASSER

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Pad - Exum

Trespasser Scenario - Upper Pad

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o} \qquad CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 50
EF = Exposure Frequency (days/yr) = 52
ED = Exposure Duration (years) = 12
CF1 = Conversion Factor (kg/mg) = 1E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 47
AT_{nc} = Averaging Time Non-cancer (days) = 4380
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor (mg/kg-day)$^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	25.2	50	0.6	52	12	1E-06	47	4380	25550	3.0E-04	7.6E-03	1.5E+00	5.9E-07
Iron	177983	50	1	52	12	1E-06	47	4380	25550	7.0E-01	3.9E-02	--	--
Manganese	6891	50	1	52	12	1E-06	47	4380	25550	2.4E-02	4.4E-02	--	--
Benzo(a)anthracene	6	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	1.5E-08
Benzo(a)pyrene	6	50	1	52	12	1E-06	47	4380	25550	3.0E-04	3.0E-03	1.0E+00	1.5E-07
Benzo(b)fluoranthene	8	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.2E-08
Benzo(k)fluoranthene	3.2	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-02	8.4E-10
Chrysene	6	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-03	1.5E-10
Dibenz(a,h)anthracene	0.1	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E+00	2.4E-09
Fluoranthene	18	50	1	52	12	1E-06	47	4380	25550	4.0E-02	7.0E-05	--	--
Indeno(1,2,3-cd)pyrene	5	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	1.4E-08
N-Nitrosodi-n-propylamine	7.1	50	1	52	12	1E-06	47	4380	25550	--	--	7.0E+00	1.3E-06
Naphthalene	1.3	50	1	52	12	1E-06	47	4380	25550	2.0E-02	1.0E-05	--	--
										Total HI =	9.3E-02	Total CR =	2.1E-06

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Pad - Exum

Trespasser Scenario - Upper Pad

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d}$$

$$CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 3677
M = Dermal Adherence Rate (mg/cm^2) = 0.02
RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific
RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific
SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	25.2	3677	0.2	0.03	52	12	1E-06	47	4380	25550	3.0E-04	5.6E-03	1.5E+00	4.3E-07
Iron	177983	3677	0.2	0	52	12	1E-06	47	4380	25550	7.0E-01	0.0E+00	--	--
Manganese	6891	3677	0.2	0	52	12	1E-06	47	4380	25550	9.6E-04	0.0E+00	--	--
Benzo(a)anthracene	5.59	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.8E-08
Benzo(a)pyrene	5.86	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-04	5.7E-03	1.0E+00	2.9E-07
Benzo(b)fluoranthene	8.33	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	4.1E-08
Benzo(k)fluoranthene	3.23	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-02	1.6E-09
Chrysene	5.90	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-03	2.9E-10
Dibenz(a,h)anthracene	0.094	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E+00	4.7E-09
Fluoranthene	18	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-02	1.3E-04	--	--
Indeno(1,2,3-cd)pyrene	5.28	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.6E-08
N-Nitrosodi-n-propylamine	7.10	3677	1.2	0.1	52	12	1E-06	47	4380	25550	--	--	7.0E+00	1.1E-05
Naphthalene	1	3677	0.2	0.13	52	12	1E-06	47	4380	25550	2.0E-02	1.9E-05	--	--
											Total HI =	1.1E-02	Total CR =	1.2E-05

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Pad - Exum

Trespasser Scenario - Upper Pad

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i} \qquad CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
PEF - Particulate Emission Factor (m3/kg) = 1.48E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	25.2	52	12	47	2	1.48E+09	4380	25550	4.29E-06	2.4E-05	1.5E+01	2.7E-10
Iron	177983	52	12	47	2	1.48E+09	4380	25550	--	--	--	--
Manganese	6891	52	12	47	2	1.48E+09	4380	25550	1.43E-05	2.0E-03	--	--
Benzo(a)anthracene	5.59	52	12	47	2	1.48E+09	4380	25550	--	--	2.1E-01	8.2E-13
Benzo(a)pyrene	5.86	52	12	47	2	1.48E+09	4380	25550	5.71E-07	4.2E-05	2.1E+00	8.6E-12
Benzo(b)fluoranthene	8.33	52	12	47	2	1.48E+09	4380	25550	--	--	2.1E-01	1.2E-12
Benzo(k)fluoranthene	3.23	52	12	47	2	1.48E+09	4380	25550	--	--	2.1E-02	4.8E-14
Chrysene	5.90	52	12	47	2	1.48E+09	4380	25550	--	--	2.1E-03	8.7E-15
Dibenz(a,h)anthracene	0.0938	52	12	47	2	1.48E+09	4380	25550	--	--	2.1E+00	1.4E-13
Fluoranthene	18.4	52	12	47	2	1.48E+09	4380	25550	--	--	--	--
Indeno(1,2,3-cd)pyrene	5.28	52	12	47	2	1.48E+09	4380	25550	--	--	2.1E-01	7.8E-13
N-Nitrosodi-n-propylamine	7.10	52	12	47	2	1.48E+09	4380	25550	--	--	7.0E+00	3.5E-11
Naphthalene	1.34	52	12	47	2	1.48E+09	4380	25550	8.57E-04	6.4E-09	1.2E-01	1.1E-13
									Total HI =	2.0E-03	Total CR =	3.1E-10

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao}}{VF * BW * ATnc * RfD_i} \qquad CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{VF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
VF - Volatilization Factor (m3/kg) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Naphthalene	1.34	52	12	47	2	4.99E+04	4380	25550	8.57E-04	1.9E-04	0.119	3.3E-09
									Total HI =	1.9E-04	Total CR =	3.3E-09

U. S. Steel Fairfield Works
Fairfield, Alabama
Lower Pad - Exum

Trespasser Scenario - Lower Pad

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o} \qquad CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 50
EF = Exposure Frequency (days/yr) = 52
ED = Exposure Duration (years) = 12
CF1 = Conversion Factor (kg/mg) = 1E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 47
AT_{nc} = Averaging Time Non-cancer (days) = 4380
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor (mg/kg-day)$^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	19.4	50	0.6	52	12	1E-06	47	4380	25550	3.0E-04	5.9E-03	1.5E+00	4.5E-07
Iron	162807	50	1	52	12	1E-06	47	4380	25550	7.0E-01	3.5E-02	--	--
Manganese	15408	50	1	52	12	1E-06	47	4380	25550	2.4E-02	9.7E-02	--	--
Benzo(a)anthracene	1.93	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	5.0E-09
Benzo(a)pyrene	2.27	50	1	52	12	1E-06	47	4380	25550	3.0E-04	1.1E-03	1.0E+00	5.9E-08
Benzo(b)fluoranthene	2.01	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	5.2E-09
Benzo(k)fluoranthene	2.03	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-02	5.3E-10
Chrysene	1.99	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-03	5.2E-11
Dibenz(a,h)anthracene	0.564	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E+00	1.5E-08
Indeno(1,2,3-cd)pyrene	1.57	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	4.1E-09
										Total HI =	1.4E-01	Total CR =	5.4E-07

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d} \qquad CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 3677
M = Dermal Adherence Rate (mg/cm^2) = 0.02
RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific
RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific
SF_d = Dermal Slope Factor (mg/kg-day)$^{-1}$ = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	19.4	3677	0.2	0.03	52	12	1E-06	47	4380	25550	3.0E-04	4.3E-03	1.5E+00	3.3E-07
Iron	162807	3677	0.2	0	52	12	1E-06	47	4380	25550	7.0E-01	0.0E+00	--	--
Manganese	15408	3677	0.2	0	52	12	1E-06	47	4380	25550	9.6E-04	0.0E+00	--	--
Benzo(a)anthracene	1.93	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	9.6E-09
Benzo(a)pyrene	2.27	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-04	2.2E-03	1.0E+00	1.1E-07
Benzo(b)fluoranthene	2.01	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	1.0E-08
Benzo(k)fluoranthene	2.03	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-02	1.0E-09
Chrysene	1.99	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-03	9.9E-11
Dibenz(a,h)anthracene	0.564	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E+00	2.8E-08
Indeno(1,2,3-cd)pyrene	1.57	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	7.8E-09
											Total HI =	6.5E-03	Total CR =	5.0E-07

U. S. Steel Fairfield Works
Fairfield, Alabama
Lower Pad - Exum

Trespasser Scenario - Lower Pad

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
PEF - Particulate Emission Factor (m3/kg) = 1.63E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	19.4	52	12	47	2	1.63E+09	4380	25550	4.29E-06	1.7E-05	1.5E+01	1.9E-10
Iron	162807	52	12	47	2	1.63E+09	4380	25550	--	--	--	--
Manganese	15408	52	12	47	2	1.63E+09	4380	25550	1.43E-05	4.0E-03	--	--
Benzo(a)anthracene	1.93	52	12	47	2	1.63E+09	4380	25550	--	--	2.1E-01	2.6E-13
Benzo(a)pyrene	2.27	52	12	47	2	1.63E+09	4380	25550	5.71E-07	1.5E-05	2.1E+00	3.0E-12
Benzo(b)fluoranthene	2.01	52	12	47	2	1.63E+09	4380	25550	--	--	2.1E-01	2.7E-13
Benzo(k)fluoranthene	2.03	52	12	47	2	1.63E+09	4380	25550	--	--	2.1E-02	2.7E-14
Chrysene	1.99	52	12	47	2	1.63E+09	4380	25550	--	--	2.1E-03	2.7E-15
Dibenz(a,h)anthracene	0.564	52	12	47	2	1.63E+09	4380	25550	--	--	2.1E+00	7.5E-13
Indeno(1,2,3-cd)pyrene	1.57	52	12	47	2	1.63E+09	4380	25550	--	--	2.1E-01	2.1E-13
									Total HI =	4.0E-03	Total CR =	1.9E-10

U. S. Steel Fairfield Works
Fairfield, Alabama
Lower Impoundment - Exum

Trespasser Scenario - Lower Impoundment

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o} \qquad CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 50
EF = Exposure Frequency (days/yr) = 52
ED = Exposure Duration (years) = 12
CF1 = Conversion Factor (kg/mg) = 1E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 47
AT_{nc} = Averaging Time Non-cancer (days) = 4380
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	61.0	50	0.6	52	12	1E-06	47	4380	25550	3.0E-04	1.8E-02	1.5E+00	1.4E-06
Iron	260000	50	1	52	12	1E-06	47	4380	25550	7.0E-01	5.6E-02	--	--
Manganese	6900	50	1	52	12	1E-06	47	4380	25550	2.4E-02	4.4E-02	--	--
Benzo(a)anthracene	8.70	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.3E-08
Benzo(a)pyrene	7.40	50	1	52	12	1E-06	47	4380	25550	3.0E-04	3.7E-03	1.0E+00	1.9E-07
Benzo(b)fluoranthene	12.0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	3.1E-08
Benzo(k)fluoranthene	5.10	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-02	1.3E-09
Chrysene	9.10	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-03	2.4E-10
Dibenz(a,h)anthracene	0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E+00	0.0E+00
Indeno(1,2,3-cd)pyrene	10.0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.6E-08
										Total HI =	1.2E-01	Total CR =	1.7E-06

U. S. Steel Fairfield Works
Fairfield, Alabama
Lower Impoundment - Exum

Trespasser Scenario - Lower Impoundment

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d}$$

$$CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 3677
M = Dermal Adherence Rate (mg/cm^2) = 0.02
RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific
RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific
SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	61.0	3677	0.2	0.03	52	12	1E-06	47	4380	25550	3.0E-04	1.4E-02	1.5E+00	1.0E-06
Iron	260000	3677	0.2	0	52	12	1E-06	47	4380	25550	7.0E-01	0.0E+00	--	--
Manganese	6900	3677	0.2	0	52	12	1E-06	47	4380	25550	9.6E-04	0.0E+00	--	--
Benzo(a)anthracene	9	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	4.3E-08
Benzo(a)pyrene	7.40	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-04	7.1E-03	1.0E+00	3.7E-07
Benzo(b)fluoranthene	12.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	6.0E-08
Benzo(k)fluoranthene	5.10	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-02	2.5E-09
Chrysene	9.10	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-03	4.5E-10
Dibenz(a,h)anthracene	0.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E+00	0.0E+00
Indeno(1,2,3-cd)pyrene	10.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	5.0E-08
											Total HI =	2.1E-02	Total CR =	1.6E-06

U. S. Steel Fairfield Works
Fairfield, Alabama
Lower Impoundment - Exum

Trespasser Scenario - Lower Impoundment

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i} \qquad CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
PEF - Particulate Emission Factor (m3/kg) = 2.14E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	61.0	52	12	47	2	2.14E+09	4380	25550	4.29E-06	4.0E-05	1.5E+01	4.5E-10
Iron	260000	52	12	47	2	2.14E+09	4380	25550	--	--	--	--
Manganese	6900	52	12	47	2	2.14E+09	4380	25550	1.43E-05	1.4E-03	--	--
Benzo(a)anthracene	9	52	12	47	2	2.14E+09	4380	25550	--	--	2.1E-01	8.9E-13
Benzo(a)pyrene	7	52	12	47	2	2.14E+09	4380	25550	5.71E-07	3.7E-05	2.1E+00	7.6E-12
Benzo(b)fluoranthene	12	52	12	47	2	2.14E+09	4380	25550	--	--	2.1E-01	1.2E-12
Benzo(k)fluoranthene	5.1	52	12	47	2	2.14E+09	4380	25550	--	--	2.1E-02	5.2E-14
Chrysene	9	52	12	47	2	2.14E+09	4380	25550	--	--	2.1E-03	9.3E-15
Dibenz(a,h)anthracene	0.0	52	12	47	2	2.14E+09	4380	25550	--	--	2.1E+00	0.0E+00
Indeno(1,2,3-cd)pyrene	10	52	12	47	2	2.14E+09	4380	25550	--	--	2.1E-01	1.0E-12

Total HI = 1.4E-03 Total CR = 4.6E-10

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao}}{VF * BW * ATnc * RfD_i} \qquad CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{VF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
VF - Volatilization Factor (m3/kg) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)

Total HI = 0.0E+00 Total CR = 0.0E+00

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Trespasser Scenario - Upper Impoundment

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o} \qquad CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 50
EF = Exposure Frequency (days/yr) = 52
ED = Exposure Duration (years) = 12
CF1 = Conversion Factor (kg/mg) = 1E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 47
AT_{nc} = Averaging Time Non-cancer (days) = 4380
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	84.3	50	0.6	52	12	1E-06	47	4380	25550	3.0E-04	2.6E-02	1.5E+00	2.0E-06
Iron	251667	50	1	52	12	1E-06	47	4380	25550	7.0E-01	5.4E-02	--	--
Manganese	8647	50	1	52	12	1E-06	47	4380	25550	2.4E-02	5.5E-02	--	--
Mercury	1.538	50	1	52	12	1E-06	47	4380	25550	3.0E-04	7.8E-04	--	--
Nickel	628	50	1	52	12	1E-06	47	4380	25550	2.0E-02	4.8E-03	--	--
Zinc	4696	50	1	52	12	1E-06	47	4380	25550	0.3	2.4E-03	--	--
Cyanide	4.81	50	1	52	12	1E-06	47	4380	25550	0.0006	1.2E-03	--	--
Benzene	5.58	50	1	52	12	1E-06	47	4380	25550	0.004	2.1E-04	0.055	8.0E-09
			1										
N- Nitrosodi-n-propylamine	1393	50	1	52	12	1E-06	47	4380	25550	--	--	7.0E+00	2.5E-04
2-Methylnaphthalene	280.2	50	1	52	12	1E-06	47	4380	25550	4.0E-03	1.1E-02	--	--
Acenaphthene	0.0	50	1	52	12	1E-06	47	4380	25550	6.0E-02	0.0E+00	--	--
Acenaphthylene	798.0	50	1	52	12	1E-06	47	4380	25550	3.0E-02	4.0E-03	--	--
Anthracene	0	50	1	52	12	1E-06	47	4380	25550	3.0E-01	0.0E+00	--	--
Benzo(a)anthracene	841	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.2E-06
Benzo(a)pyrene	796	50	1	52	12	1E-06	47	4380	25550	3.0E-04	4.0E-01	1.0E+00	2.1E-05
Benzo(b)fluoranthene	845	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.2E-06
Benzo(k)fluoranthene	393.5	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-02	1.0E-07
Carbazole	806.7	50	1	52	12	1E-06	47	4380	25550	--	--	2.0E-02	4.2E-07
Chrysene	706	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-03	1.8E-08
Dibenz(a,h)anthracene	61.1	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E+00	1.6E-06
Fluoranthene	1937	50	1	52	12	1E-06	47	4380	25550	4.0E-02	7.3E-03	--	--
Fluorene	758.3	50	1	52	12	1E-06	47	4380	25550	4.0E-02	2.9E-03	--	--
Indeno(1,2,3-cd)pyrene	576	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	1.5E-06
Dibenzofuran	340.0	50	1	52	12	1E-06	47	4380	25550	4.0E-03	1.3E-02	--	--
Naphthalene	1411.6	50	1	52	12	1E-06	47	4380	25550	2.0E-02	1.1E-02	--	--
Phenanthrene	2620	50	1	52	12	1E-06	47	4380	25550	3.0E-02	1.3E-02	--	--
Pyrene	1439	50	1	52	12	1E-06	47	4380	25550	3.0E-02	7.3E-03	--	--
										Total HI =	6.2E-01	Total CR =	2.8E-04

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Trespasser Scenario - Upper Impoundment

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d}$$

$$CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 3677
M = Dermal Adherence Rate (mg/cm^2) = 0.02
RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific
RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific
SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	84.3	3677	0.2	0.03	52	12	1E-06	47	4380	25550	3.0E-04	1.9E-02	1.5E+00	1.5E-06
Iron	251667	3677	0.2	0	52	12	1E-06	47	4380	25550	7.0E-01	0.0E+00	--	--
Manganese	8647	3677	0.2	0	52	12	1E-06	47	4380	25550	9.6E-04	0.0E+00	--	--
Mercury	1.54	3677	0.2	0	52	12	1E-06	47	4380	25550	2.1E-05	0.0E+00	--	--
Nickel	627.7	3677	0.2	0	52	12	1E-06	47	4380	25550	8.0E-04	0.0E+00	--	--
Zinc	4696	3677	0.2	0	52	12	1E-06	47	4380	25550	0.3	0.0E+00	--	--
Cyanide	4.81	3677	0.2	0	52	12	1E-06	47	4380	25550	0.0006	0.0E+00	--	--
N- Nitrosodi-n-propylamine	1393	3677	0.2	0.1	52	12	1E-06	47	4380	25550	--	--	7.0E+00	3.7E-04
2-Methylnaphthalene	280.2	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-03	2.0E-02	--	--
Acenaphthylene	798.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	7.7E-03	--	--
Benzo(a)anthracene	841	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	4.2E-06
Benzo(a)pyrene	796	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-04	7.7E-01	1.0E+00	4.0E-05
Benzo(k)fluoranthene	393.5	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-02	2.0E-07
Carbazole	807	3677	1.2	0.1	52	12	1E-06	47	4380	25550	--	--	2.0E-02	3.7E-06
Chrysene	706	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-03	3.5E-08
Dibenz(a,h)anthracene	61.1	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E+00	3.0E-06
Fluoranthene	1937	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-02	1.4E-02	--	--
Fluorene	758.3	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-02	5.5E-03	--	--
Indeno(1,2,3-cd)pyrene	576	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	2.9E-06
Dibenzofuran	340.0	3677	1.2	0.1	52	12	1E-06	47	4380	25550	4.0E-03	1.1E-01	--	--
Naphthalene	1412	3677	0.2	0.13	52	12	1E-06	47	4380	25550	2.0E-02	2.0E-02	--	--
Phenanthrene	2620	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	2.5E-02	--	--
Pyrene	1439	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	1.4E-02	--	--
												Total HI = 1.0E+00		Total CR = 4.3E-04

U. S. Steel Fairfield Works
Fairfield, Alabama
Upper Impoundment - Exum

Trespasser Scenario - Upper Impoundment

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i} \qquad CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
PEF - Particulate Emission Factor (m3/kg) = 2.03E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	84.3	52	12	47	2	2.03E+09	4380	25550	4.29E-06	5.9E-05	1.5E+01	6.5E-10
Iron	251667	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Manganese	8647	52	12	47	2	2.03E+09	4380	25550	1.43E-05	1.8E-03	--	--
Mercury	1.54	52	12	47	2	2.03E+09	4380	25550	8.57E-05	5.4E-08	--	--
Cyanide	4.8	52	12	47	2	2.03E+09	4380	25550	2.29E-04	6.3E-08	--	--
Benzene	5.58	52	12	47	2	2.03E+09	4380	25550	8.57E-03	1.9E-09	0.0273	7.8E-14
N- Nitrosodi-n-propylamine	1393	52	12	47	2	2.03E+09	4380	25550	--	--	7	5.0E-09
2-Methylnaphthalene	280	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Benzo(a)anthracene	841	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-01	9.0E-11
Benzo(a)pyrene	796	52	12	47	2	2.03E+09	4380	25550	5.71E-07	4.2E-03	2.1E+00	8.6E-10
Benzo(b)fluoranthene	845	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-01	9.1E-11
Benzo(k)fluoranthene	393.5	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-02	4.2E-12
Carbazole	807	52	12	47	2	2.03E+09	4380	25550	--	--	2.0E-02	8.3E-12
Chrysene	706	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-03	7.6E-13
Dibenz(a,h)anthracene	61.1	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E+00	6.6E-11
Fluoranthene	1937	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Fluorene	758.3	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Indeno(1,2,3-cd)pyrene	576	52	12	47	2	2.03E+09	4380	25550	--	--	2.1E-01	6.2E-11
Dibenzofuran	340.0	52	12	47	2	2.03E+09	4380	25550	4.00E-03	2.5E-07	--	--
Naphthalene	1412	52	12	47	2	2.03E+09	4380	25550	8.57E-04	4.9E-06	1.2E-01	8.6E-11
Phenanthrene	2620	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
Pyrene	1439	52	12	47	2	2.03E+09	4380	25550	--	--	--	--
									Total HI =	6.1E-03	Total CR =	7.2E-09

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao}}{VF * BW * ATnc * RfD_i} \qquad CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{VF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
VF - Volatilization Factor (m3/kg) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Benzene	5.58	52	12	47	2	3.81E+03	4380	25550	8.57E-03	1.0E-03	0.0273	4.2E-08
Naphthalene	1412	52	12	47	2	4.99E+04	4380	25550	8.57E-04	2.0E-01	0.119	3.5E-06
									Total HI =	2.0E-01	Total CR =	3.5E-06

U. S. Steel Fairfield Works
Fairfield, Alabama
BF/QBOP Sludge Disposal Area - Exum

Adolescent Trespasser Scenario

Soil Ingestion

$$HI = \frac{CS * IRS * BIO * EF * ED * CF1}{BW * AT_{nc} * RfD_o} \qquad CR = \frac{CS * IRS * BIO * EF * ED * CF1 * SF_o}{BW * AT_c}$$

where: HQ = Hazard Quotient (unitless)
CR = Cancer Risk (unitless)
CS = Soil concentration (mg/kg) = Chemical-specfic
IRS = Ingestion Rate of Soil (mg/day) = 50
EF = Exposure Frequency (days/yr) = 52
ED = Exposure Duration (years) = 12
CF1 = Conversion Factor (kg/mg) = 1E-06
BIO = Bioavailability (unitless)
BW = Body Weight (kg) = 47
AT_{nc} = Averaging Time Non-cancer (days) = 4380
RfD_o = Oral Reference Dose (mg/kg-day) = Chemical-specfic
SF_o = Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ = Chemical-specfic
AT_c = Averaging Time Cancer (days) = 25550

Chemical	CS (mg/kg)	IRS (mg/day)	BIO (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_o (mg/kg-day)	HQ (unitless)	SF_o $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	0.0	50	0.6	52	12	1E-06	47	4380	25550	3.0E-04	0.0E+00	1.5E+00	0.0E+00
Iron	270000	50	1	52	12	1E-06	47	4380	25550	7.0E-01	5.8E-02	--	--
Manganese	6800	50	1	52	12	1E-06	47	4380	25550	2.4E-02	4.3E-02	--	--
Mercury	0	50	1	52	12	1E-06	47	4380	25550	3.0E-04	0.0E+00	--	--
Nickel	0	50	1	52	12	1E-06	47	4380	25550	2.0E-02	0.0E+00	--	--
Zinc	0	50	1	52	12	1E-06	47	4380	25550	0.3	0.0E+00	--	--
Cyanide	0.00	50	1	52	12	1E-06	47	4380	25550	0.0006	0.0E+00	--	--
Benzene	0.00	50	1	52	12	1E-06	47	4380	25550	0.004	0.0E+00	0.055	0.0E+00
			1										
N- Nitrosodi-n-propylamine	0	50	1	52	12	1E-06	47	4380	25550	--	--	7.0E+00	0.0E+00
2-Methylnaphthalene	0.0	50	1	52	12	1E-06	47	4380	25550	4.0E-03	0.0E+00	--	--
Acenaphthene	0.0	50	1	52	12	1E-06	47	4380	25550	6.0E-02	0.0E+00	--	--
Acenaphthylene	0.0	50	1	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
Anthracene	0	50	1	52	12	1E-06	47	4380	25550	3.0E-01	0.0E+00	--	--
Benzo(a)anthracene	0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	0.0E+00
Benzo(a)pyrene	0	50	1	52	12	1E-06	47	4380	25550	3.0E-04	1.3E-04	1.0E+00	6.5E-09
Benzo(b)fluoranthene	0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	0.0E+00
Benzo(k)fluoranthene	0.0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-02	0.0E+00
Carbazole	0.0	50	1	52	12	1E-06	47	4380	25550	--	--	2.0E-02	0.0E+00
Chrysene	0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-03	0.0E+00
Dibenz(a,h)anthracene	0.0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E+00	0.0E+00
Fluoranthene	0	50	1	52	12	1E-06	47	4380	25550	4.0E-02	0.0E+00	--	--
Fluorene	0.0	50	1	52	12	1E-06	47	4380	25550	4.0E-02	0.0E+00	--	--
Indeno(1,2,3-cd)pyrene	0	50	1	52	12	1E-06	47	4380	25550	--	--	1.0E-01	0.0E+00
Dibenzofuran	0.0	50	1	52	12	1E-06	47	4380	25550	4.0E-03	0.0E+00	--	--
Naphthalene	0.0	50	1	52	12	1E-06	47	4380	25550	2.0E-02	0.0E+00	--	--
Phenanthrene	0	50	1	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
Pyrene	0	50	1	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
										Total HI =	1.0E-01	Total CR =	6.5E-09

U. S. Steel Fairfield Works
Fairfield, Alabama
BF/QBOP Sludge Disposal Area - Exum

Adolescent Trespasser Scenario

Soil Dermal Contact

$$HQ = \frac{CS * SA * M * RAF_d * EF * ED * CF1}{BW * AT_{nc} * RfD_d}$$

$$CR = \frac{CS * SA * M * AB * EF * ED * CF1 * SF_d}{BW * AT_c}$$

where: SA = Exposed Skin Surface Area (cm^2) = 3677
M = Dermal Adherence Rate (mg/cm^2) = 0.02
RAF_d = Dermal Relative Absorption Factor (unitless) = chemical-specific
RfD_d = Dermal Reference Dose (mg/kg-day) = chemical-specific
SF_d = Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ = chemical-specific

Chemical	CS (mg/kg)	SA (mg^2)	M (mg/cm^2)	RAF_d (unitless)	EF (day/yr)	ED (yr)	CF1 (kg/mg)	BW (kg)	AT_{nc} (days)	AT_c (days)	RfD_d (mg/kg-day)	HQ (unitless)	SF_d $(mg/kg\text{-}day)^{-1}$	CR (unitless)
Arsenic	0.0	3677	0.2	0.03	52	12	1E-06	47	4380	25550	3.0E-04	0.0E+00	1.5E+00	0.0E+00
Iron	270000	3677	0.2	0	52	12	1E-06	47	4380	25550	7.0E-01	0.0E+00	--	--
Manganese	6800	3677	0.2	0	52	12	1E-06	47	4380	25550	9.6E-04	0.0E+00	--	--
Mercury	0.00	3677	0.2	0	52	12	1E-06	47	4380	25550	2.1E-05	0.0E+00	--	--
Nickel	0	3677	0.2	0	52	12	1E-06	47	4380	25550	8.0E-04	0.0E+00	--	--
Zinc	0	3677	0.2	0	52	12	1E-06	47	4380	25550	0.3	0.0E+00	--	--
Cyanide	0.00	3677	0.2	0	52	12	1E-06	47	4380	25550	0.0006	0.0E+00	--	--
N- Nitrosodi-n-propylamine	0	3677	0.2	0.1	52	12	1E-06	47	4380	25550	--	--	7.0E+00	0.0E+00
2-Methylnaphthalene	0.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-03	0.0E+00	--	--
Acenaphthylene	0.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
Benzo(a)anthracene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	0.0E+00
Benzo(a)pyrene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-04	2.4E-04	1.0E+00	1.2E-08
Benzo(k)fluoranthene	0.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-02	0.0E+00
Carbazole	0	3677	1.2	0.1	52	12	1E-06	47	4380	25550	--	--	2.0E-02	0.0E+00
Chrysene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-03	0.0E+00
Dibenz(a,h)anthracene	0.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E+00	0.0E+00
Fluoranthene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-02	0.0E+00	--	--
Fluorene	0.0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	4.0E-02	0.0E+00	--	--
Indeno(1,2,3-cd)pyrene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	--	--	1.0E-01	0.0E+00
Dibenzofuran	0.0	3677	1.2	0.1	52	12	1E-06	47	4380	25550	4.0E-03	0.0E+00	--	--
Naphthalene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	2.0E-02	0.0E+00	--	--
Phenanthrene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
Pyrene	0	3677	0.2	0.13	52	12	1E-06	47	4380	25550	3.0E-02	0.0E+00	--	--
											Total HI =	2.4E-04	Total CR =	1.2E-08

U. S. Steel Fairfield Works
Fairfield, Alabama
BF/QBOP Sludge Disposal Area - Exum

Adolescent Trespasser Scenario

Inhalation of Particulates

$$HQ = \frac{CS * EF * ED * IR_{ao}}{PEF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{PEF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
PEF - Particulate Emission Factor (m3/kg) = 1.73E+09

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	PEF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Arsenic	0.0	52	12	47	2	1.73E+09	4380	25550	4.29E-06	0.0E+00	1.5E+01	0.0E+00
Iron	270000	52	12	47	2	1.73E+09	4380	25550	--	--	--	--
Manganese	6800	52	12	47	2	1.73E+09	4380	25550	1.43E-05	1.7E-03	--	--
Mercury	0.00	52	12	47	2	1.73E+09	4380	25550	8.57E-05	0.0E+00	--	--
Cyanide	0.0	52	12	47	2	1.73E+09	4380	25550	2.29E-04	0.0E+00	--	--
Benzene	0.00	52	12	47	2	1.73E+09	4380	25550	8.57E-03	0.0E+00	0.0273	0.0E+00
N- Nitrosodi-n-propylamine	0	52	12	47	2	1.73E+09	4380	25550	--	--	7	0.0E+00
2-Methylnaphthalene	0	52	12	47	2	1.73E+09	4380	25550	--	--	--	--
Benzo(a)anthracene	0	52	12	47	2	1.73E+09	4380	25550	--	--	2.1E-01	0.0E+00
Benzo(a)pyrene	0	52	12	47	2	1.73E+09	4380	25550	5.71E-07	1.5E-06	2.1E+00	3.2E-13
Benzo(b)fluoranthene	0	52	12	47	2	1.73E+09	4380	25550	--	--	2.1E-01	0.0E+00
Benzo(k)fluoranthene	0.0	52	12	47	2	1.73E+09	4380	25550	--	--	2.1E-02	0.0E+00
Carbazole	0	52	12	47	2	1.73E+09	4380	25550	--	--	2.0E-02	0.0E+00
Chrysene	0	52	12	47	2	1.73E+09	4380	25550	--	--	2.1E-03	0.0E+00
Dibenz(a,h)anthracene	0.0	52	12	47	2	1.73E+09	4380	25550	--	--	2.1E+00	0.0E+00
Fluoranthene	0	52	12	47	2	1.73E+09	4380	25550	--	--	--	--
Fluorene	0.0	52	12	47	2	1.73E+09	4380	25550	--	--	--	--
Indeno(1,2,3-cd)pyrene	0	52	12	47	2	1.73E+09	4380	25550	--	--	2.1E-01	0.0E+00
Dibenzofuran	0.0	52	12	47	2	1.73E+09	4380	25550	4.00E-03	0.0E+00	--	--
Naphthalene	0	52	12	47	2	1.73E+09	4380	25550	8.57E-04	0.0E+00	1.2E-01	0.0E+00
Phenanthrene	0	52	12	47	2	1.73E+09	4380	25550	--	--	--	--
Pyrene	0	52	12	47	2	1.73E+09	4380	25550	--	--	--	--
									Total HI =	1.7E-03	Total CR =	3.2E-13

Inhalation of Vapors

$$HQ = \frac{CS * EF * ED * IR_{ao}}{VF * BW * ATnc * RfD_i}$$

$$CR = \frac{CS * EF * ED * IR_{ao} * SF_i}{VF * BW * ATc}$$

where: IR_{ao} - Hourly outdoor inhalation rate (m^3/hr) = 1
ET = Exposure Time (hrs/day) = 2
IR_{ao} - Dailly outdoor inhalation rate (m^3/day) = 2
VF - Volatilization Factor (m3/kg) - Chemical Specific

RfDi = Inhalation Reference Dose (mg/kg-day) Chemical Specific
SFi = Inhalation Slope Factor (mg/kg-day)$^{-1}$ Chemical Specific

Chemical	CS (mg/kg)	EF (day/yr)	ED (yr)	BW (kg)	IR_{ao} (m^3/day)	VF (m^3/kg)	AT_{nc} (days)	AT_c (days)	RfDi (mg/kg-day)	HQ (unitless)	SFi (mg/kg-day)$^{-1}$	CR (unitless)
Benzene	0.00	52	12	47	2	3.81E+03	4380	25550	8.57E-03	0.0E+00	0.0273	0.0E+00
Naphthalene	0	52	12	47	2	4.99E+04	4380	25550	8.57E-04	0.0E+00	0.119	0.0E+00
									Total HI =	0.0E+00	Total CR =	0.0E+00

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