Brownfield Cleanup Program Application

for Steel Winds Facility
Lackawanna, New York

BQ Energy, LLC
Pawling, New York

April 2006 0083-003-100

Prepared For:

BQ Energy, LLC
Pawling, New York

Prepared By:

TurnKey Environmental Restoration, LLC

726 Exchange Street, Suite 624, Buffalo, New York | phone: (716) 856-0599 | fax: (716) 856-0583

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

BROWNFIELD CLEANUP PROGRAM (BCP) APPLICATION

ECL ARTICLE 27 / TITLE 14

DEPARTMENT USE ONLY
BCP SITE #:______________

07/05

Section I. Requestor Information

NAME BQ Energy, LLC		
ADDRESS PO Box 338		
CITY/TOWN Pawling, NY	ZIP CODE 12564	
PHONE 914-844-0894	FAX 914-729-1039	E-MAIL paul.curran@bqenergy.com
NAME OF REQUESTOR'S REPRESENTATIVE Paul F. Curran		
ADDRESS PO Box 338		
CITY/TOWN Pawling, NY	ZIP CODE 12564	
PHONE 914-844-0894	FAX 914-729-1039	E-MAIL paul.curran@bqenergy.com
NAME OF REQUESTOR'S CONSULTANT TurnKey Environmental Restoration, LLC (Paul Werthman, P.E.)		
ADDRESS 726 Exchange Street, Suite 624		
CITY/TOWN Buffalo, NY	ZIP CODE 14210	
PHONE 716-856-0635	FAX 716-856-0583	E-MAIL pwerthman@benchmarkees.c
NAME OF REQUESTOR'S ATTORNEY David Flynn, Phillips Lytle LLP		
ADDRESS 3400 HSBC Center		
CITY/TOWN Buffalo, NY	ZIP CODE 14203	
PHONE 716-847-8400	FAX 716-852-6100	E-MAIL dflynn@phillipslytle.com

THE REQUESTOR MUST CERTIFY THAT IT IS EITHER A PARTICIPANT OR VOLUNTEER IN ACCORDANCE WITH ECL § 27-1405 (1) BY CHECKING ONE OF THE BOXES BELOW:

☐ PARTICIPANT
A requestor who either 1) was the owner of the site at the time of the disposal of hazardous waste or discharge of petroleum or 2) is otherwise a person responsible for the contamination, unless the liability arises solely as a result of ownership, operation of, or involvement with the site subsequent to the disposal of hazardous waste or discharge of petroleum.

☑ VOLUNTEER
A requestor other than a participant, including a requestor whose liability arises solely as a result of ownership, operation of or involvement with the site subsequent to the disposal of hazardous waste or discharge of petroleum.

NOTE: By checking this box, the requestor certifies that he/she has exercised appropriate care with respect to the hazardous waste found at the facility by taking reasonable steps to: i) stop any continuing discharge; ii) prevent any threatened future release; and iii) prevent or limit human, environmental, or natural resource exposure to any previously released hazardous waste.

Requestor Relationship to Property (check one):

☐ Previous Owner ☐ Current Owner ☐ Potential /Future Purchaser ☑ Other Leasee

If requestor is not the site owner, requestor will have access to the property throughout the BCP project. ☑ Yes ☐ No
(Note: proof of site access must be submitted for non-owners)

Section II. Site Information Summary Sheet

SITE /PROPERTY NAME: Tecumseh Redevelopment, Inc.

ADDRESS/LOCATION 1951 Hamburg Turnpike CITY/TOWN Lackawanna ZIP CODE 14218

MUNICIPALITY(IF MORE THAN ONE, LIST ALL): City of Lackawanna

COUNTY Erie SITE SIZE (ACRES) 30.8

LATITUDE (degrees/minutes/seconds) 42 ° 48 ' 58 " LONGITUDE (degrees/minutes/seconds) 78 ° 51 ' 16 "

HORIZONTAL COLLECTION METHOD: Erie County Mapping HORIZONTAL REFERENCE DATUM: State Planar

FOR EACH PARCEL, FILL OUT THE FOLLOWING TAX MAP INFORMATION (if more than three parcels, attach additional information)

Parcel Address	Parcel No.	Section No.	Block No.	Lot No.	Acreage
1951 Hamburg Turnpike (Partial)		141.11	1	1.111	30.8

1. Do the site boundaries correspond to tax map metes and bounds? ☐Yes ☑ No
   If no, please attach a metes and bounds description of the site.
2. Is the required site map attached to the application? (application will not be processed without site map) ☑Yes ☐ No
3. Is the site part of a designated En-zone pursuant to Tax Law § 21(b)(6)? ☑Yes ☐ No
   For more information go to:
   http://www.nylovesbiz.com/Productivity_Energy_and_Environment/BrownField_Redevelopment/default.asp
   If yes, identify area (name) Census Tract 012200
   ☐50% ☑100% of the site is in the En-zone (check one)

SITE DESCRIPTION NARRATIVE: The Site is currently vacant land on the elevated Lake Erie shoreline. The property is slag-filled created land by the former Bethlehem Steel. Nine subareas have been designated for use as windmill foundations.

List of Existing Easements (type here or attach information)

Easement Holder Description

List of Permits Relating to the Proposed Site (type here or attach information)

Type	Issuing Agency	Description
Building Permit	City of Lackawanna	Permit for wind energy facility construction

Initials of each Requestor: RC ________ ________ ________ ________ ________

Section III. Current Site Owner/Operator Information

OWNER'S NAME (if different from requestor) Tecumseh Redevelopment, Inc		
ADDRESS 4020 Kinross Parkway		
CITY/TOWN Richfield, OH	ZIP CODE 44286	
PHONE 330-659-9165	FAX 330-659-7434	E-MAIL keith.nagel@mittalsteel.com
OPERATOR'S NAME (if different from requestor or owner) TurnKey Environmental Restoration, LLC (Paul Werthman, P.E.)		
ADDRESS 726 Exchange Street, Suite 624		
CITY/TOWN Buffalo, NY	ZIP CODE 14210	
PHONE 716-856-0635	FAX 716-856-0583	E-MAIL pwerthman@benchmarkees

Section IV. Requestor Eligibility Information (Please refer to ECL § 27-1407)

If answering "yes" to any of the following questions, please provide an explanation as an attachment.

1. Are any enforcement actions pending against the requestor regarding this site? ☐Yes ☑No
2. Is the site subject to an existing order for the contamination? ☑Yes ☐No
3. Is the requestor subject to an outstanding claim by the Spill Fund for this site? ☐Yes ☑No
4. Has the requestor violated any provision of ECL Article 27? ☐Yes ☑No
5. Has the requestor been previously denied entry to the BCP? ☐Yes ☑No
6. Has the requestor committed a negligent or intentionally tortuous act regarding hazardous waste or petroleum? ☐Yes ☑No
7. Has the requestor been convicted of a criminal offense that involves a violent felony, fraud, bribery, perjury, theft, or offense against public administration? ☐Yes ☑No
8. Has the requestor knowingly falsified statements or concealed material facts in a matter related to the Department? ☐Yes ☑No
9. Has the requestor, based on the provisions of ECL Article 27-1407 (or a similar provision of federal or state law), committed an act or failed to act, and such act or failure to act could be the basis for denial of a BCP application? ☐Yes ☑No

Section V. Site Eligibility Information (Please refer to ECL § 27-1405)

1. Is the site listed on the National Priorities List? ☐Yes ☑No
2. Is the site listed on the NYS Registry of Inactive Hazardous Waste Disposal Sites? ☐Yes ☑No
   If yes, please provide: Site #________ Class #________
3. Is the site subject to a permit under ECL article 27, title 9, other than an Interim Status facility? ☐Yes ☑No
   If yes, please provide: Permit type:________ EPA ID Number:________
   Date permit issued:________ Permit expiration date:________
4. Is the site subject to a cleanup order under navigation law Article 12 or ECL Article 17 Title 10? ☐Yes ☑No
   If yes, please provide: Order #________
5. Is the site subject to a state or federal enforcement action related to hazardous waste or petroleum? ☐Yes ☑No
   If yes, please provide explanation as an attachment.

Section VI. Project Description

Please attach a description of the project which includes the following components:

- Purpose and scope of the project
- Estimated project schedule

Section VII. Site's Environmental History

To the extent that existing information/studies/reports are available to the requestor, please attach the following:

1. **Environmental Reports**

   A phase I environmental site assessment report prepared in accordance with ASTM E 1527 (American Society for Testing and Materials: Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process), and all environmental reports related to contaminants on or emanating from the site.

   If a final investigation report is included, indicate whether it meets the requirements of ECL Article 27-1415(2): ☐Yes ☐No

2. **Sampling Data: Indicate known contaminants and the media which are known to have been affected:**

Contaminant Category	Soil	Groundwater	Surface Water	Sediment	Soil Gas
Petroleum					
Chlorinated Solvents					
Other VOCs					
SVOCs					
Metals					
Pesticides					
PCBs					
Other*					

*Please describe: ____________________

3. **Suspected Contaminants: Indicate suspected contaminants and the media which may have been affected:**

Contaminant Category	Soil	Groundwater	Surface Water	Sediment	Soil Gas
Petroleum	X				
Chlorinated Solvents					
Other VOCs					
SVOCs	X				
Metals	X				
Pesticides					
PCBs					
Other*					

*Please describe: ____________________

4. INDICATE KNOWN OR SUSPECTED SOURCES OF CONTAMINANTS:

☐Above Ground Pipeline or Tank ☐Lagoons or Ponds ☐Underground Pipeline or Tank ☐Surface Spill or Discharge
☐Routine Industrial Operations ☑Dumping or Burial of Wastes ☐Septic tank/lateral field ☐Drums or Storage Containers
☐Adjacent Property ☐Seepage Pit or Dry Well ☐Foundry Sand ☐Electroplating
☑Coal Gas Manufacture ☐Industrial Accident ☐Unknown

Other: Coke and Steel Production

5. INDICATE PAST LAND USES:

☐Coal Gas Manufacturing ☐Manufacturing ☐Agricultural Co-op ☐Dry Cleaner ☐Salvage Yard ☐Bulk Plant
☐Pipeline ☐Service Station ☐Landfill ☐Tannery ☐Electroplating ☐Unknown

Other: Slag Disposal

6. **Owners**

   A list of previous owners with names, last known addresses and telephone numbers (describe requestor's relationship, if any, to each previous owner listed. If no relationship, put "none").

7. **Operators**

   A list of previous operators with names, last known addresses and telephone number (describe requestor's relationship, if any, to each previous operator listed. If no relationship, put "none").

Section VIII. Contact List Information

Please attach, at a minimum, the names and addresses of the following:

1. The chief executive officer and zoning board chairperson of each county, city, town and village in which the site is located.
2. Residents, owners, and occupants of the site and properties adjacent to the site.
3. Local news media from which the community typically obtains information.
4. The public water supplier which services the area in which the site is located.
5. Any person who has requested to be placed on the site contact list.
6. The administrator of any school or day care facility located on or near the site.
7. The location of a document repository for the project (e.g., local library). In addition, attach a copy of a letter sent to the repository acknowledging that it agrees to act as the document repository for the site.

Section IX. Land Use Factors (Please refer to ECL § 27-1415(3))

Current Use: ☐ Residential ☐ Commercial ☐ Industrial ☑ Vacant ☐ Recreational (check all that apply)

Intended Use: ☐Unrestricted ☐ Residential ☐ Commercial ☑ Industrial

Please check the appropriate box and provide an explanation as an attachment if appropriate. Provide a copy of the local zoning classifications, comprehensive zoning plan designations, and/or current land use approvals.

	Yes	No
1. Do current historical and/or recent development patterns support the proposed use? (See #12 below re: discussion of area land uses)	☑	☐
2. Is the proposed use consistent with applicable zoning laws/maps?	☑	☐
3. Is the proposed use consistent with applicable comprehensive community master plans, local waterfront revitalization plans, designated Brownfield Opportunity Area plans, other adopted land use plans?	☑	☐
4. Are there any Environmental Justice Concerns? (See §27-1415(3)(p)).	☐	☑
5. Are there any federal or State land use designations relating to this site?	☐	☑
6. Do the population growth patterns and projections support the proposed use?	☑	☐
7. Is the site accessible to existing infrastructure?	☑	☐
8. Are there important cultural resources, including federal or state historic or heritage sites or Native American religious sites proximate to the site?	☐	☑
9. Are there important federal, state or local natural resources, including waterways, wildlife refuges, wetlands, or critical habitats of endangered or threatened species proximate to the site?	☑	☐
10. Are there floodplains proximate to the site?	☑	☐
11. Are there any institutional controls currently applicable to the site?	☑	☐

12. Describe on attachment the proximity to real property currently used for residential use, and to urban, commercial, industrial, agricultural, and recreational areas.

13. Describe on attachment the potential vulnerability of groundwater to contamination that might migrate from the site, including proximity to wellhead protection and groundwater recharge areas.

14. Describe on attachment the geography and geology of the site.

Statement of Certification and Signatures

(By requestor who is an individual)
I hereby affirm that information provided on this form and its attachments is true and complete to the best of my knowledge and belief. I am aware that any false statement made herein is punishable as a Class A misdemeanor pursuant to section 210.45 of the Penal Law.

Date: __________ Signature: ______________________________ Print Name: ________________________________

(By an requestor other than an individual)

I certify that I am MANAGING DIRECTOR (title) of BQ ENERGY (entity); that I am authorized by that entity to make this application; that this application was prepared by me or under my supervision and direction; and that information provided on this form and its attachments is true and complete to the best of my knowledge and belief. I am aware that any false statement made herein is punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law.

Date: 10 APRIL 2006 Signature: PAUL CURRAN Print Name: PAUL CURRAN

SUBMITTAL INFORMATION

Three (3) complete copies are required.

- **Two (2)** copies, one hard copy with original signatures and one electronic copy in Portable Document Format (PDF) on a CD or diskette, must be sent to:

  Chief, Site Control Section
  New York State Department of Environmental Conservation
  Division of Environmental Remediation
  625 Broadway
  Albany, NY 12233-7020

- **One (1)** hard copy must be sent to the DEC regional contact in the regional office covering the county in which the site is located. Please check our website for the address of our regional offices: http://www.dec.state.ny.us/website/der/index.html

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FOR DEPARTMENT USE ONLY

BCP SITE T&A CODE:______________ **LEAD OFFICE:**________________________________

LIST OF APPLICATION ATTACHMENTS

NYSDEC Brownfield Cleanup Program Application
BQ Energy, LLC – Steel Winds Site
Lackawanna, New York

Attachment No.	Description
1	Property Owner Authorization Letter
2	Site Location Map and Site Plan
3	Tax Map, Metes and Bounds Description
4	Project Description and Schedule
5	Proposed Redevelopment Master Plan
6	Previous Environmental Investigations/Assessments
7	Listing of Previous Site Owners
8	Listing of Previous Site Operators
9	Contact List Information
10	Document Repository Confirmation Letter
11	Environmental Factors and Historic Land Use Considerations
12	Nearby Land-Use Map
13	Groundwater Vulnerability Assessment
14	Description of Site Geography/Geology

ATTACHMENT 1

PROPERTY OWNER AUTHORIZATION LETTER

Tecumseh Redevelopment Inc.
4020 Kinross Lakes Parkway
Cleveland Ohio 44286

March 31, 2006

Mr. Paul Curran
BQ Energy, LLC
PO Box 338
Pawling, New York 12564

Re: Brownfields Cleanup Program Application
BQ Energy, LLC
Access to 1951 Hamburg Turnpike, Lackawanna, NY

Dear Mr. Curran:

Tecumseh Redevelopment Inc. is the owner of 1951 Hamburg Turnpike, Lackawanna, NY and acknowledges BQ Energy, LLC as an applicant for 15.5 acres, more or less, comprising nine sub areas within our site for a wind energy project under the Brownfield Cleanup Program (BCP) for this property. Tecumseh Redevelopment authorizes BQ Energy, LLC unlimited access to the property proposed for the BCP to perform required environmental investigations and testing.

Please contact me at (330) 659-9100 if you have questions or require additional information.

Sincerely,

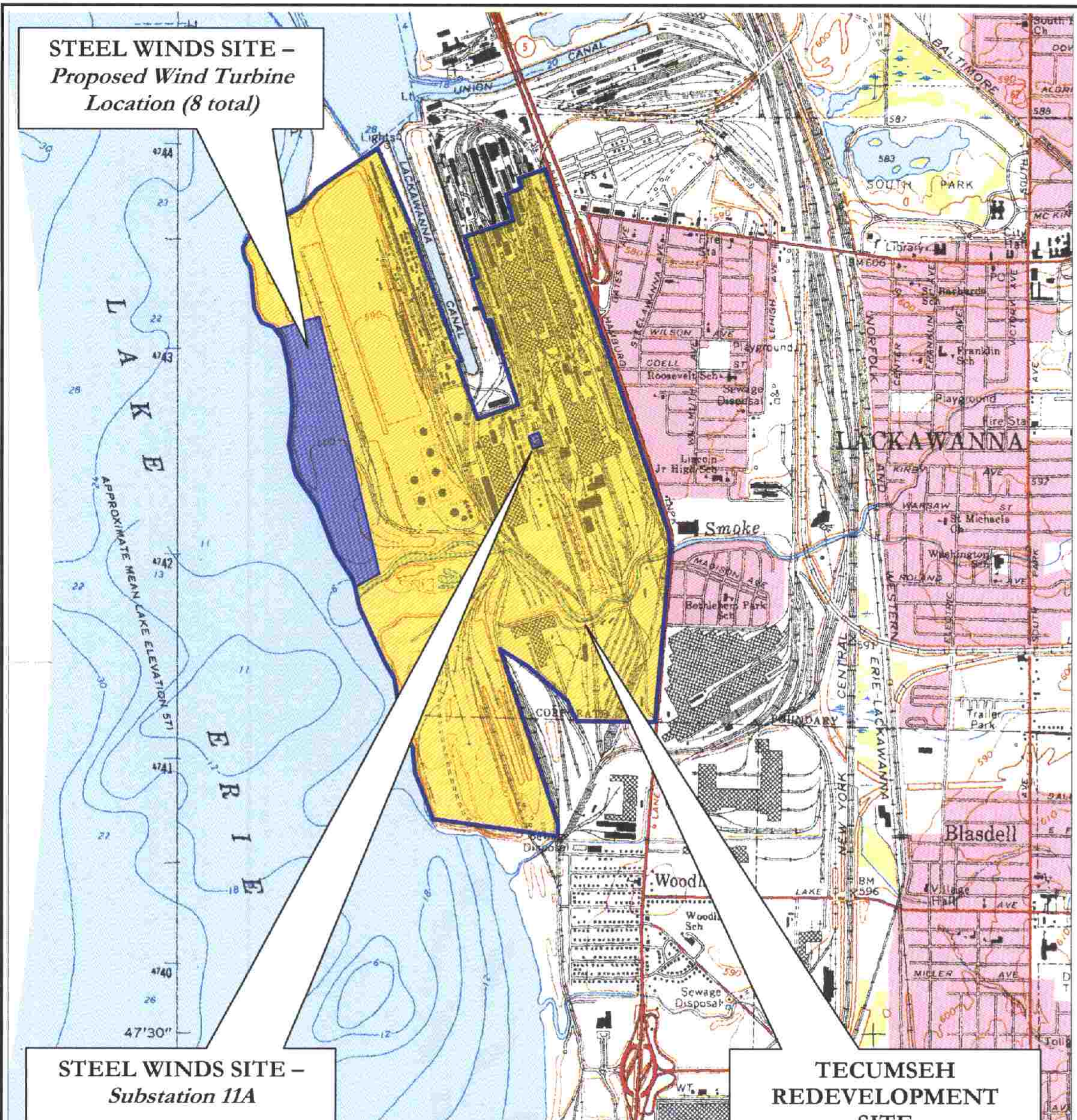
Keith Nagel
General Manager

cc: Elton Parker, Squire, Sanders and Dempsey
Paul Werthman, TurnKey Environmental Restoration

ATTACHMENT 2

SITE LOCATION MAP AND SITE MAP

FIGURE 2-1



DeLorme

TurnKey Environmental Restoration, LLC
726 EXCHANGE STREET
SUITE 624
BUFFALO, NEW YORK 14210
(716) 856-635

PROJECT NO.: 0083-003-100

DATE: MARCH 2006

DRAFTED BY: BCH

SITE LOCATION AND VICINITY MAP

BROWNFIELD CLEANUP PROGRAM APPLICATION

BQ ENERGY, LLC - STEEL WINDS SITE
LACKAWANNA, NEW YORK

PREPARED FOR

TECUMSEH REDEVELOPMENT, INC.

FILEPATH:g:\cad\turnkey\tecumseh redevelopment\brownfield cleanup program (bcp)\steel winds\attachment 2\figure 2-1; site vicinity and location map.dwg

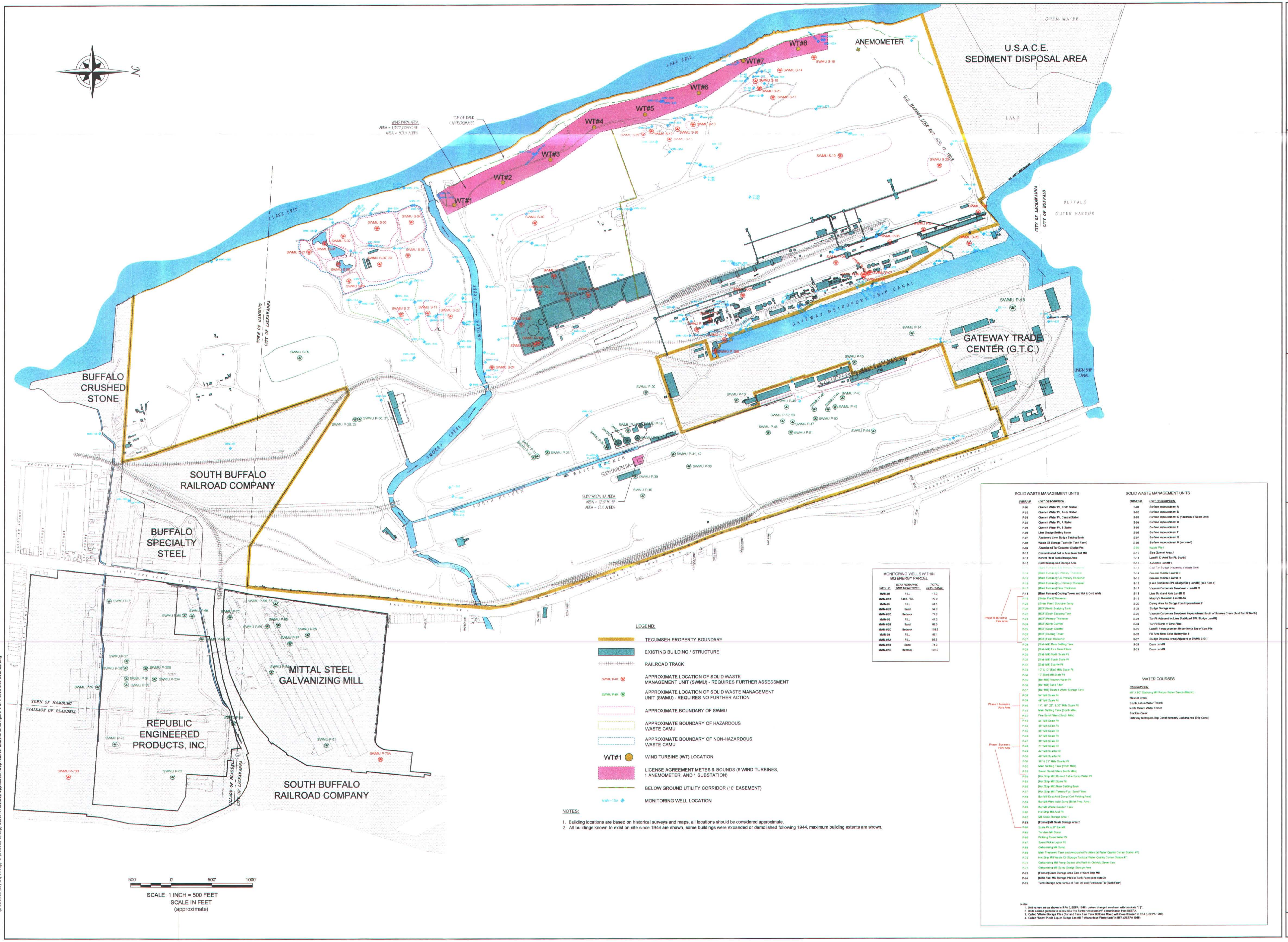


FIGURE 3-2

METES AND BOUNDS

BROWNFIELD CLEANUP PROGRAM APPLICATION
FORMER BETHLEHEM STEEL LACKAWANNA COKE DIVISION
LACKAWANNA, NEW YORK

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

DRAWN BY: BCH
DATE: MARCH 2006
CHECKED BY: THF
APPROVED BY:

DISCLAIMER:
PROPERTY OF BENCHMARK EES, PLLC. IMPORTANT: THIS DRAWING PRINT IS LOANED FOR MUTUAL ASSISTANCE AND AS SUCH IS SUBJECT TO RECALL AT ANY TIME. INFORMATION CONTAINED HEREON IS NOT TO BE DISCLOSED OR REPRODUCED IN ANY FORM FOR THE BENEFIT OF PARTIES OTHER THAN NECESSARY SUBCONTRACTORS & SUPPLIERS WITHOUT THE WRITTEN CONSENT OF BENCHMARK EES, PLLC.

SEAL

REVISIONS

NO.	BY	DATE	REMARKS

TURNKEY ENVIRONMENTAL RESTORATION, LLC
726 EXCHANGE STREET
SUITE 624
BUFFALO, NEW YORK 14210
(716) 856-635

JOB NO.: 0083-003-100

ATTACHMENT 3

TAX MAP, METES AND BOUNDS DESCRIPTION

EXHIBIT A

Metes and Bounds - Description of the Premises

Premise – Substation 11A

Beginning at a true point of beginning, on the southeast fence corner of the existing fence line around the Substation 11A building, whose U.S. State Plane, Zone NY West 3103 coordinates are approximately : North 1,026,956, East 1,076,243, thence the land bounded by the following six (6) courses and distances: (1) South seventy-one degrees one minute forty seven seconds West (S. 71-01'-47" W.) approximately one hundred one and fifty-one one-hundredths (101.51') feet, to a point on the southwest corner of said mentioned perimeter fence line, (2) North nineteen degrees fifty-six minutes fifty six seconds West (N. 19-56'-56" W.) approximately one hundred forty-three and sixty-two one-hundredths (143.62') feet, to a point on the northwest corner of said mentioned fence line, (3) North eighty-three degrees seventeen minutes twenty-five seconds East (N. 83-17-25 E.) approximately thirty-four and twenty-three one-hundredths (34.23') feet, to a point of deflection on the said mentioned north perimeter fence line, (4) North eighty-eight degrees thirty-eight minutes ten seconds East (N. 88-38'-10" E.) approximately forty-two and one one-hundredth (42.01') feet, to a point of deflection on the said mentioned north fence line, (5) South seventy-eight degrees twenty-one minutes fifty-nine seconds East (S. 78-21'-59" E.) approximately thirty-four and seventy-one one-hundredths (34.71') feet, to a point on the northeast corner of said mentioned fence, (6) South nineteen degrees seventeen minutes twenty-four seconds E. (S. 19-17'-24" E.) approximately one hundred five and ninety-five one-hundredths (105.95') feet, to said true point of beginning; Containing three-tenths (0.30) of an acre, more or less.

Premise – Wind Turbine Parcel

Beginning at a point whose U.S. State Plane, Zone NY West 3103 coordinates are approximately: North 1,026,662.52, East 1,072,100.72, further identified as being the point of intersection of the centerline of a ten (10') foot wide utility easement to Substation 11A, with a point on the easterly line of the wind turbine parcel (between wind turbines #4 and #5), thence the land bounded by the following seventeen (17) courses and distances: (1) North twelve degrees thirty-four minutes fifteen seconds West (N.12-34'-15"W.) approximately four hundred forty-eight and twenty-seven one-hundredths (448.27') feet to a point, (2) North twenty-one degrees seven minutes forty-nine seconds West (N.21-07'-49" W.) approximately seven hundred thirty-two and sixty-seven one-hundredths (732.67') feet to a point, (3) North thirty-four degrees fifty-three minutes thirty-four seconds West (N.34-53'-34" W.) approximately seven hundred twelve and eighteen one-hundredths (712.18') feet to a point, (4) North twelve degrees thirty-five minutes thirty-three seconds West (N.12-35'-33" W.) approximately nine hundred eighty-three and fifty-five one-hundredths (983.55') feet to a point, (5) South ninety degrees West (S.90-00'-00"W.) approximately two hundred five and fifty-one one-hundredths (205.51') feet to a point, (6) South eleven degrees fifty-seven minutes fifty-seven seconds East (S.11-57'-57"E.) approximately five hundred twenty-seven and forty-two one-hundredths (527.42') feet to a point, (7) South twenty-three degrees five minutes fifty seconds East (S.23-05'-50"E.) approximately four hundred fifty-six and eleven one-hundredths (456.11') feet to a point, (8) South fifteen degrees twenty-one minutes five seconds East (S.15-21'-05"E.) approximately one-hundred eighty-one and twelve one-hundredths (181.12') feet to a point, (9) South twenty-six degrees twenty-one minutes forty seconds East (S.26-21'-40"E.) approximately seven hundred thirty and thirty-three one-hundredths (730.33') feet to a point, (10) South fourteen degrees six minutes nine seconds East (S.14-06'-09"E.) approximately one thousand one hundred ninety-three and eighty one-hundredths (1193.80') feet to a point, (11) South thirty-four degrees fifty-nine minutes thirty seconds East (S.34-59'-30"E.) approximately seven hundred twenty-three and five one-hundredths (723.05') feet to a point, (12) South twenty-four degrees forty minutes eight seconds East (S.24-40'-08"E.) approximately one thousand two hundred seventy-seven and nineteen one-hundredths (1277.19') feet to a point, (13) South thirty-three degrees twenty-seven minutes thirty-five seconds East (S.33-27'-35"E.) approximately one hundred fifty-six and fifty-four one-hundredths (156.54') feet to a point, (14) North sixty-two degrees fifty-one minutes thirty-four seconds East (N.62-51'-34"E.) approximately two hundred eighty and ninety-six one-hundredths (280.96') feet to a point, (15) North twenty-four degrees fifty-six minutes fifty-five seconds West (N.24-56-55W.) approximately one thousand four hundred forty-eight and thirty-seven one-hundredths (1448.37') feet to a point, (16) North thirty-five degrees forty minutes twenty-six seconds West (N.35-40'-26"W.) approximately six hundred ninety-five and twenty-one one-hundredths (695.21') feet to a point, (17) North twelve degrees thirty-four minutes fifteen seconds West (N.12-34-15"W.) approximately one hundred thirty-eight and thirteen one-hundredths (138.13') feet to said true point of beginning; hence this bounded area containing approximately thirty and five tenths (30.5) acres.

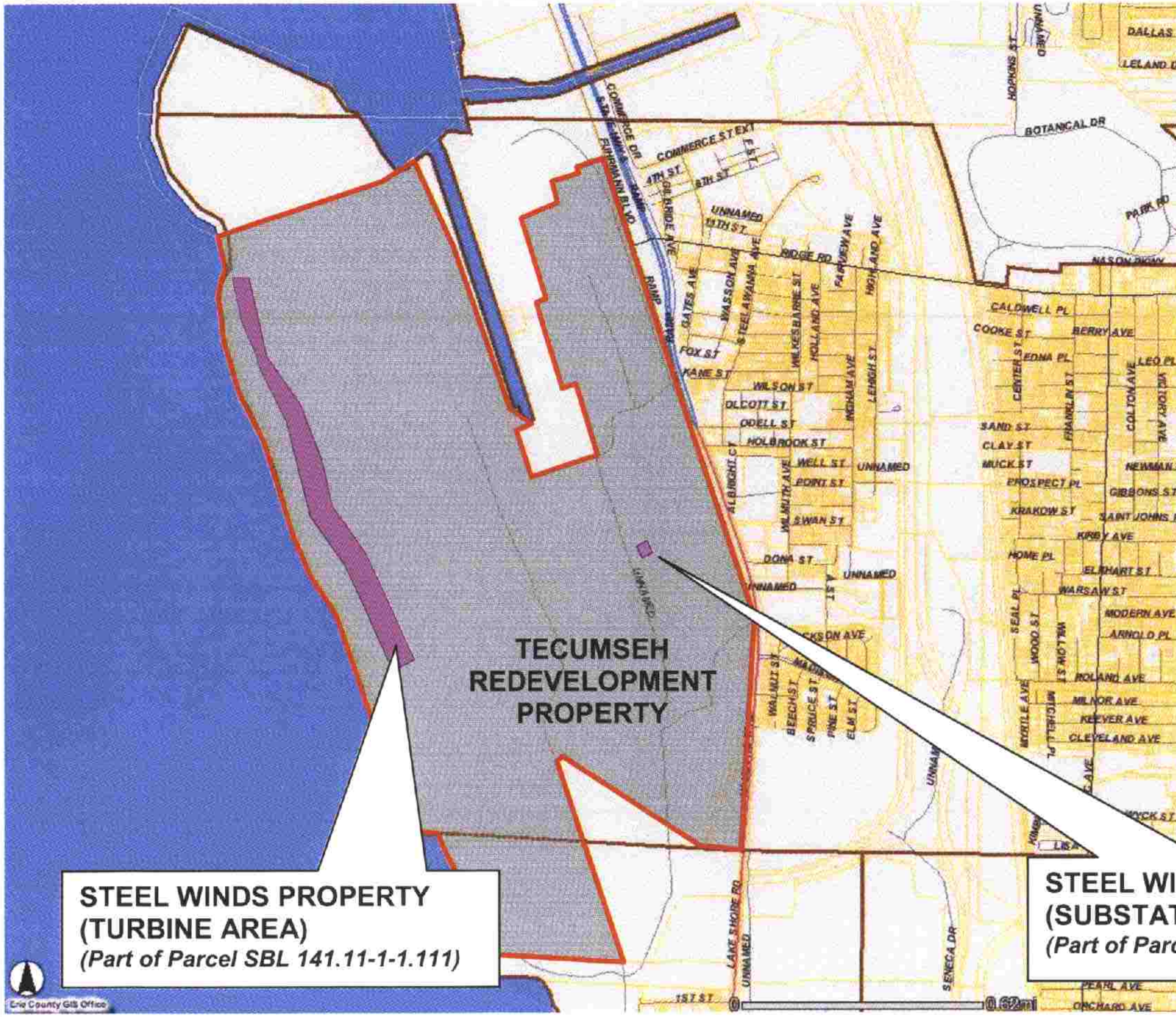
Easement Lands Description

Substation 11A Premise to Wind Turbines (WT #4 – WT #5)

A ten (10') foot wide utility land easement will be granted by Lessor to the Lessee between the Substation 11A Premise traversing to a point between wind turbines WT #4 and WT #5, beginning at a point described as the approximate northwest fence corner of the existing fence around the perimeter of Substation 11A, whose U.S. State Plane, Zone NY West 3103 coordinates are approximately North 1,027,058, East 1,076,098, thence the following six (6) courses and distances: (1) North sixteen degrees fifty-seven minutes five seconds West (N. 16-57'-05" W.) approximately five-hundred and seventy-five one-hundredths (500.75') feet to a point, (2) South seventy degrees thirty-nine minutes fifty-seven seconds West (S. 70-39'-57" W.) approximately one-thousand eight-hundred thirty-three and thirty-nine one-hundredths (1833.39') feet to a point, (3) North sixteen degrees twenty-eight minutes thirty-seven seconds West (N. 16-28'-37" W.) approximately seventy-four and four hundredths (74.01') feet to a point, (4) South seventy-nine degrees ten minutes forty-two seconds West (S. 79-10'-42" W.) approximately one-thousand two-hundred nineteen and sixty-nine one-hundredths

(1219.69') feet to a point, (5) North sixteen degrees fifty-five minutes thirty-nine seconds West (N. 16-55'-39" W.) approximately two-hundred sixteen and thirty-seven one-hundredths (216.37') feet to a point, (6) South sixty-nine degrees twenty minutes twenty-two seconds West (S. 69-20'-22" W.) approximately eight-hundred ninety-six and ninety-six one-hundredths (1898.96') feet to a point, described as a point on the easterly wind turbine parcel line (P.O.L.) between wind turbines WT #4 and WT #5.

END EXHIBIT A



TurnKey Environmental Restoration, LLC
726 EXCHANGE STREET
SUITE 624
BUFFALO, NEW YORK 14210
(716) 856-0635

PROJECT NO.: 0083-003-100

DATE: MARCH 2006

DRAFTED BY: BCH

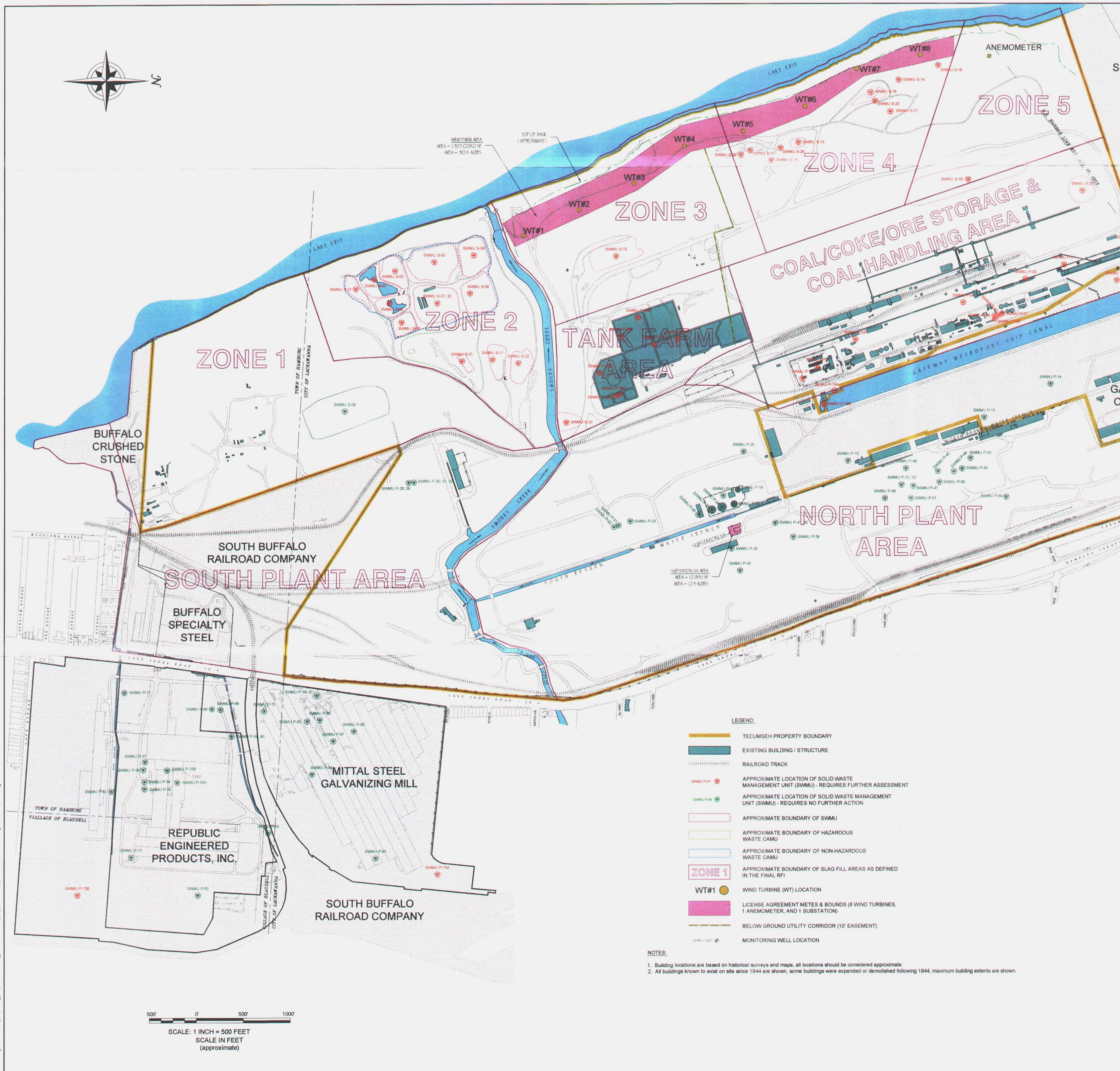
TAX MAP

BROWNFIELD CLEANUP PROGRAM APPLICATION

LACKAWANNA, NEW YORK
BQ ENERGY, LLC - STEEL WINDS SITE

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

FIGURE 3-1



NOTES:

1. Building locations are based on historical surveys and maps, all locations should be considered approximate.
2. All buildings known to exist on site since 1944 are shown, some buildings were expanded or demolished following 1944, maximum building extents are shown.

SOLID WASTE MANAGEMENT UNITS

SWMU ID	UNIT DESCRIPTION
P-01	Quench Water Pit, North Station
P-02	Quench Water Pit, Arctic Station
P-03	Quench Water Pit, Central Station
P-04	Quench Water Pit, A Station
P-05	Quench Water Pit, B Station
P-06	Lime Sludge Settling Basin
P-07	Abadoned Lime Sludge Settling Basin
P-08	Waste Oil Storage Tanks [in Tank Farm]
P-09	Abandoned Tar Decanter Sludge Pits
P-10	Contaminated Soil in Area Near Ball Mill
P-11	Benzol Plant Tank Storage Area
P-12	Spill Cleanup Soil Storage Area
P-13	[Blast Furnace] A-B Primary Thickener
P-14	[Blast Furnace] C Primary Thickener
P-15	[Blast Furnace] F-G Primary Thickener
P-16	[Blast Furnace] H-J Primary Thickener
P-17	[Blast Furnace] Final Thickener
P-18	[Blast Furnace] Cooling Tower and Hot & Cold Wells
P-19	[Sinter Plant] Thickener
P-20	[Sinter Plant] Scrubber Sump
P-21	[BOF] North Scalping Tank
P-22	[BOF] South Scalping Tank
P-23	[BOF] Primary Thickener
P-24	[BOF] North Clarifier
P-25	[BOF] South Clarifier
P-26	[BOF] Cooling Tower
P-27	[BOF] Final Thickener
P-28	[Slab Mill] Main Settling Tank
P-29	[Slab Mill] Five Sand Filters
P-30	[Slab Mill] North Scale Pit
P-31	[Slab Mill] South Scale Pit
P-32	[Slab Mill] Scarfer Pit
P-33	10" & 12" [Bar] Mills Scale Pit
P-34	13" [Bar] Mill Scale Pit
P-35	[Bar Mill] Process Water Pit
P-36	[Bar Mill] Sand Filter
P-37	[Bar Mill] Treated Water Storage Tank
P-38	54" Mill Scale Pit
P-39	48" Mill Scale Pit
P-40	14", 18", 28", & 35" Mills Scale Pit
P-41	Main Settling Tank [South Mills]
P-42	Five Sand Filters [South Mills]
P-43	44" Mill Scale Pit
P-44	40" Mill Scale Pit
P-45	36" Mill Scale Pit
P-46	32" Mill Scale Pit
P-47	30" Mill Scale Pit
P-48	21" Mill Scale Pit
P-49	44" Mill Scarfer Pit
P-50	40" Mill Scarfer Pit
P-51	30" & 21" Mills Scarfer Pit
P-52	Main Settling Tank [North Mills]
P-53	Seven Sand Filters [North Mills]
P-54	[Hot Strip Mill] Runout Table Spray Water Pit
P-55	[Hot Strip Mill] Scale Pit
P-56	[Hot Strip Mill] Main Settling Basin
P-57	[Hot Strip Mill] Twenty-Four Sand Filters
P-58	Bar Mill East Acid Sump [Coil Pickling Area]
P-59	Bar Mill West Acid Sump [Billet Prep. Area]
P-60	Bar Mill Waste Solution Tank
P-61	Hot Strip Mill Acid Pit
P-62	Mill Scale Storage Area 1
P-63	[Former] Mill Scale Storage Area 2
P-64	Scale Pit at 8" Bar Mill
P-65	Tandem Mill Sump
P-66	Pickling Rinse Water Pit
P-67	Spent Pickle Liquor Pit
P-68	Galvanizing Mill Sump
P-69	Main Treatment Tank and Associated Facilities [at Water Quality Control Station #7]
P-70	Hot Strip Mill Waste Oil Storage Tank [at Water Quality Control Station #7]
P-71	Galvanizing Mill Pump Station Wet Well for Old Acid Sewer Line
P-72	Galvanizing Mill Sump Sludge Storage Area
P-73	[Former] Drum Storage Area East of Cord Strip Mill
P-74	[Solid Fuel Mix Storage Piles in Tank Farm] (see note 3)
P-75	Tank Storage Area for No. 6 Fuel Oil and Petroleum Tar [Tank Farm]

Phase III Business Park Area: P-17, P-19 – P-27
Phase II Business Park Area: P-38 – P-42
Phase I Business Park Area: P-42 – P-53, P-64

SOLID WASTE MANAGEMENT UNITS

SWMU ID	UNIT DESCRIPTION
S-01	Surface Impoundment A
S-02	Surface Impoundment B
S-03	Surface Impoundment C (Hazardous Waste Unit)
S-04	Surface Impoundment D
S-05	Surface Impoundment E
S-06	Surface Impoundment F
S-07	Surface Impoundment G
S-08	Surface Impoundment H (not used)
S-09	Waste Pile I
S-10	Slag Quench Area J
S-11	Landfill K [Acid Tar Pit, South]
S-12	Asbestos Landfill L
S-13	Coal Tar Sludge (Hazardous Waste Unit)
S-14	General Rubble Landfill N
S-15	General Rubble Landfill O
S-16	[Lime Stabilized SPL Sludge/Slag Landfill] (see note 4)
S-17	Vacuum Carbonate Blowdown - Landfill Q
S-18	Lime Dust and Kish Landfill R
S-19	Murphy's Mountain Landfill AA
S-20	Drying Area for Sludge from Impoundment F
S-21	Sludge Storage Area
S-22	Vacuum Carbonate Blowdown Impoundment South of Smokes Creek [Acid Tar Pit North]
S-23	Tar Pit Adjacent to [Lime Stabilized SPL Sludge Landfill]
S-24	Tar Pit North of Lime Plant
S-25	Landfill / Impoundment Under North End of Coal Pile
S-26	Fill Area Near Coke Battery No. 8
S-27	Sludge Disposal Area [Adjacent to SWMU S-01)
S-28	Drum Landfill
S-29	Drum Landfill

WATER COURSES

DESCRIPTION

45" X 90" Slabbing Mill Return Water Trench (filled in)
Blasdell Creek
South Return Water Trench
North Return Water Trench
Smokes Creek
Gateway Metroport Ship Canal (formerly Lackawanna Ship Canal)

Notes:

1. Unit names are as shown in RFA (USEPA 1988), unless changed as shown with brackets " [ ] ".
2. Units colored green have received a "No Further Assessment" determination from USEPA.
3. Called "Waste Storage Piles (Tar and Tank Fuel Tank Bottoms Mixed with Coke Breeze)" in RFA (USEPA 1988).
4. Called "Spent Pickle Liquor Sludge Landfill P (Hazardous Waste Unit)" in RFA (USEPA 1988).

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JOB NO.: 0083-003-100

NO.	BY	DATE	REVISIONS	REMARKS

DRAWN BY:	BCH
DATE:	MARCH 2006
CHECKED BY:	THF
APPROVED BY:	

SITE PLAN

BROWNFIELD CLEANUP PROGRAM APPLICATION
FORMER BETHLEHEM STEEL LACKAWANNA COKE DIVISION
LACKAWANNA, NEW YORK

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

SEAL

FIGURE 2-2

ATTACHMENT 4

PROJECT DESCRIPTION & SCHEDULE

BQ Energy, LLC
Steel Winds Site
Brownfield Cleanup Program Application

Project Description and Schedule

Background

Tecumseh Redevelopment, Inc. (Tecumseh) owns approximately 1,100 acres of land at 1951 Hamburg Turnpike; approximately 2 miles south of the City of Buffalo (see Attachment 2 Figure 1). The majority of Tecumseh's property is located in the City of Lackawanna (the City), with portions of the property extending into the Town of Hamburg. Tecumseh's property is bordered by: NY State Route 5 (Hamburg Turnpike) on the east; Lake Erie to the west and northwest; and other industrial properties to the south and the northeast. Figure 2 (in Attachment 2) provides an overview of the Tecumseh Property, including major leased or licensed parcels, and adjacent parcels owned by others.

The Tecumseh property is located on a portion of the site of the former Bethlehem Steel Corporation (BSC) Lackawanna Works in a primarily industrial area. The property was formerly used for the production of steel, coke and related products by Bethlehem Steel Corporation (BSC). Steel production on the property was discontinued in 1983 and the coke ovens ceased activity in 2000. Tecumseh acquired the property, along with other BSC assets, out of bankruptcy in 2003.

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the entire former Bethlehem Steel Lackawanna Works was initiated by BSC under an Administrative Order issued by the United States Environmental Protection Agency (USEPA) in 1990. Tecumseh completed the RFI in December 2004. USEPA and the New York State Department of Environmental Conservation (NYSDEC) are currently reviewing the RFI. Tecumseh is presently negotiating an Order on Consent with the NYSDEC to undertake corrective measures at certain solid waste management units (SWMUs) primarily on the western slag fill and coke manufacturing portion of the property.

Tecumseh has signed a Memorandum of Understanding (MOU) with Erie County and the City of Lackawanna to promote and implement redevelopment of the former BSC Lackawanna property following cleanup. The conceptual Redevelopment Master Plan for the redevelopment of the entire 1,100-acre site has been prepared by Tecumseh as illustrated in Attachment 5 Figure 1. Approximately 310-acres along the eastern boundary of the Tecumseh site are planned for phased redevelopment as a Business Park. Tecumseh has entered into a Brownfield Cleanup Agreement with the NYSDEC to investigate, remediate, and redevelop the Phase I Business Park. Tecumseh has also submitted an application to the NYSDEC for the

Phase II and III Business Parks to also participate in the Brownfield Cleanup Program. A determination of eligibility by NYSDEC is pending for those parcels.

A portion of the Redevelopment Master Plan incorporates a parcel designated for redevelopment with wind energy facilities, a golf course, and/or a passive recreational park. BQ Energy, LLC has entered into a lease agreement with Tecumseh (see Attachment 1) to construct and operate windmills and supporting power generation equipment and infrastructure on approximately 31-acres of the above-referenced parcel. The wind energy facilities and the associated property, hereafter referred to as the "Steel Winds Site," "subject properties," or the "Site," are submitted to the NYSDEC within these attachments for entrance into New York State's Brownfield Cleanup Program (BCP).

As a condition of the BQ-Tecumseh lease agreement, BQ will be conducting an engineering feasibility study for development of a "clean" coal gasification and synthetic natural gas production facility on the former Coke Works portion of the Tecumseh site.

Known and Suspected Environmental Conditions

The proposed Steel Winds Site is located on a portion of the former BSC Lackawanna Works that was created from the historic disposal of slag fill (Slag Fill Areas- Zones 3, 4, and 5 - see Attachment 2 Figure 2) along the Lake Erie shoreline. The slag and other industrial fill materials contain highly variable and sometimes elevated concentrations of metals, as well as semi-volatile and volatile organic compounds. Proximate to the site, several SWMUs (see Attachment 2 Figure 2) were identified and evaluated as part of RCRA Facility Assessment and RCRA Facility Investigation activities. These SWMUs include S-12 through S-18, S-23, S-28, and S-29. SWMUs S-12, S-13, S-16, and S-29 were recommended for "no further action" in the RFI. The remaining SWMUs in the Zone 3 and Zone 4 Slag Fill Area that encompass the Steel Winds facility are recommended for further study as part of a RCRA Corrective Measures Study (CMS) to be undertaken by Tecumseh.

Based upon historical data review and site use, the main potential Chemicals of Potential Concern on the Steel Winds site are semi-volatile organic compounds SVOCs (base-neutral fraction) in surface and subsurface soil/fill. SVOCs may originate from several sources, including greases, lubricating and hydraulic oils, and fuels associated with the operation of former steel mills, as well as coal handling, coke manufacturing, and coal tar processing operations historically conducted on the Site.

In addition to these constituents, metals associated with steel manufacturing are also expected to be ubiquitous in surface and subsurface soil/fill at the Site.

<u>Schedule</u>

A proposed Project Schedule is attached as Figure 4-1.

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PROJECT NO.: 0083-003-100
DATE: MARCH 2006
DRAFTED BY: BCH

PROJECT SCHEDULE

BROWNFIELD CLEANUP PROGRAM APPLICATION

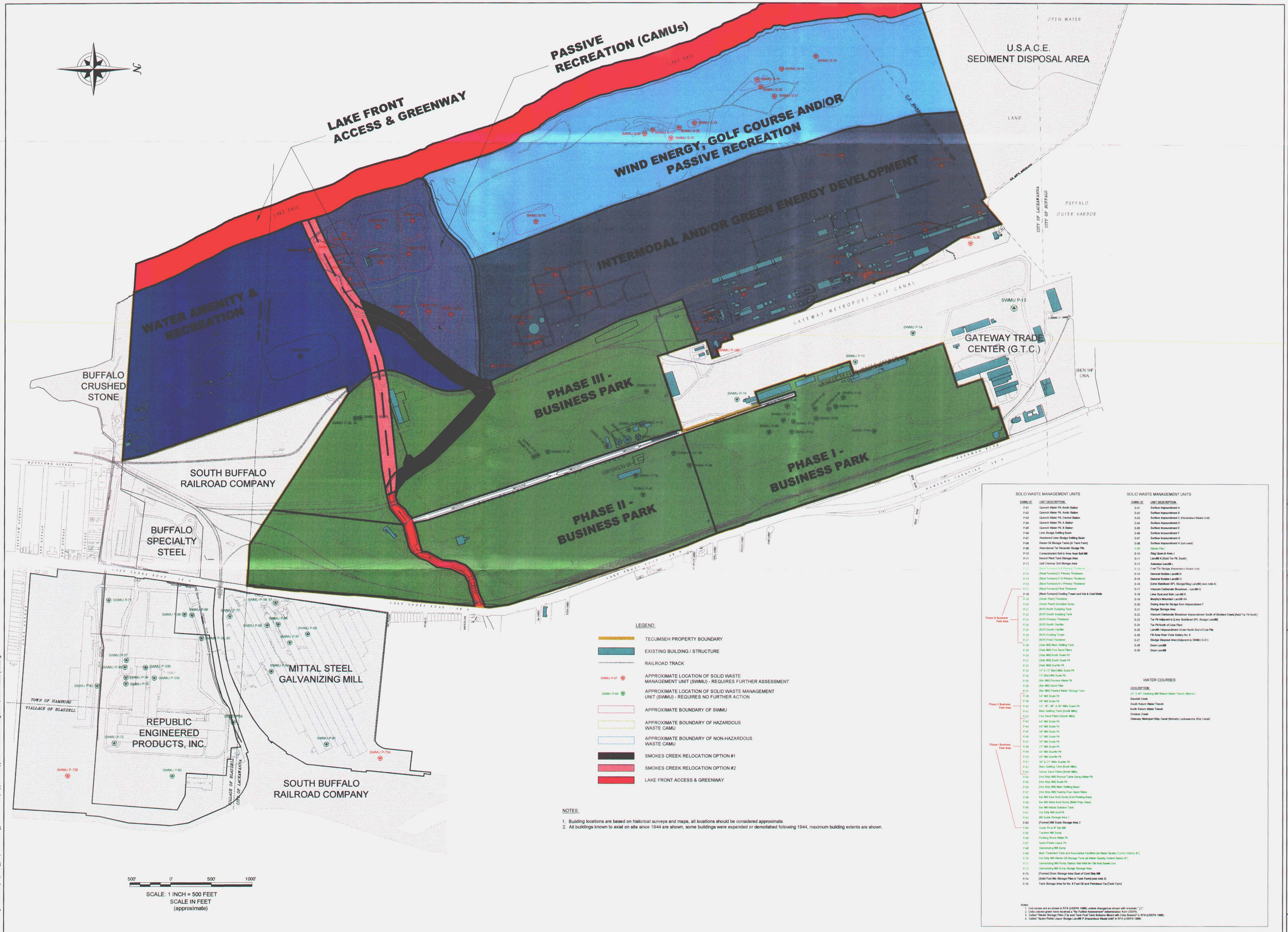
LACKAWANNA, NEW YORK
BQ ENERGY, LLC - STEEL WINDS SITE

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

FIGURE 4-1

ATTACHMENT 5

PROPOSED (DRAFT) REDEVELOPMENT MASTER PLAN MAP



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NO.	BY	DATE	REMARKS

SEAL

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REDEVELOPMENT MASTER PLAN

BROWNFIELD CLEANUP PROGRAM APPLICATION
FORMER BETHLEHEM STEEL LACKAWANNA COKE DIVISION
LACKAWANNA, NEW YORK

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

FIGURE 5-1

ATTACHMENT 6

PREVIOUS ENVIRONMENTAL INVESTIGATIONS/ASSESSMENTS

Attached are copies of the text portion of each of the SMWU Assessment Reports for the SMWUs proximate to the Steel Winds Site. A copy of the full RCRA Facility Investigation (RFI) report, including appendices, has been submitted to the Regional office of the New York State Department of Environmental Conservation under separate cover.

SWMU ASSESSMENT REPORT
ASBESTOS LANDFILL
(SWMU S-12)

BETHLEHEM STEEL CORPORATION
LACKAWANNA, NEW YORK

SEPTEMBER 2004

BETHLEHEM STEEL CORPORATION
2600 HAMBURG TURNPIKE
LACKAWANNA, NEW YORK 14218

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FIGURES
(Following Text)

Figure 1 Site Location Map for Asbestos Landfill L (SWMU S-12)

Figure 2 Monitoring Well/Piezometer Location Map with Groundwater Elevation Contours (Fill Unit)

TABLES
(Following Figures)

Table 1 Site Specific Hazardous Constituents and Indicator Parameters (Constituents of Potential Interest

Table 2 Summary of Groundwater Analytical Results: SWMU S-12

APPENDICES

Appendix A USEPA Comments

Appendix B Deed Restriction

Appendix C Site Inspection Records

Appendix D Phase II-B Soil Gas Data and Sampling Protocols

Appendix E Asbestos Permit Information

1.0 INTRODUCTION

This report documents the results of an environmental assessment of Asbestos Landfill L at Bethlehem Steel Corporation's (BSC's) Lackawanna, New York facility. Asbestos Landfill L, designated by the United States Environmental Protection Agency (USEPA) as Solid Waste Management Unit (SWMU) S-12, received bagged asbestos (USEPA 1988). The Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (USEPA, 1988), however, speculated that SWMU S-12 possibly received other materials as well (USEPA 1993), although there is no supporting documentation. The USEPA has required that a RCRA Facility Investigation (RFI) of this and other SWMUs at the BSC facility be completed in accordance with the Administrative Order on Consent (AOC) signed by BSC and USEPA in 1990 (USEPA 1990). The RFI has been conducted in phases (Phases I, IIA, IIB, IIC, and III), and included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. In 1992, BSC submitted a Preliminary SWMU Assessment report for SWMU S-12. Appendix A provides the USEPA and New York Department of Environmental Conservation (NYSDEC) comments regarding the Preliminary SWMU Assessment. This report evaluates SWMU data available to BSC as of November 2001.

1.1 Description

SWMU S-12 is located north of Smokes Creek, along the southwest edge of Zone 4 of the Lackawanna facility's Slag Fill Area (SFA) (Figure 1). It was excavated in an area of the SFA where molten slag was poured and allowed to cool. SWMU S-12 is approximately 100 feet long by 25 feet wide by 16 feet deep at an approximate elevation of 578 feet above mean sea level (msl) and filled to a depth of approximately 7 feet below grade. The local groundwater table lies at an approximate elevation of 573 feet above msl, providing a 5-foot separation between the stored materials and the local groundwater.

All of the material placed in the landfill was stored in plastic bags and covered with a 2- to 3-foot layer of fine granular slag, with the top of the cover lying at 4 to 5 feet below grade. A 4-foot berm of slag surrounds the landfill on the west, south, and east sides. The north side consists of a slope from the surrounding grade down to the top of the slag cover. The slope likely was used during construction of the landfill.

1.2 History

SWMU S-12 is a New York State Department of Environmental Conservation - (NYSDEC) permitted asbestos landfill (Permit No. 2278; Facility No. 15S12) designed and operated exclusively for the purpose of containing asbestos under New York State Environmental Conservation Law, Article 27, Title 7, Part 360. As specified in the permit, no RCRA hazardous wastes or petroleum products were placed in the asbestos landfill. Asbestos is not a RCRA-listed hazardous waste and, therefore, is not subject to RCRA hazardous waste management requirements.

From October 1980 until steel-making operations were shut down in 1983, SWMU S-12 was used for the disposal of asbestos that was collected as a result of plant operations (e.g., repairing/replacing asbestos insulation from plant facilities). SWMU S-12 was originally identified as Asbestos Landfill "R" but between 1980 and 1988, BSC renamed the location Asbestos Landfill "L". Typical material disposed of in SWMU S-12 included pipe and coke oven battery insulation. This material was placed in plastic bags, tagged, and sealed prior to disposal. An estimated 450 cubic yards of asbestos and 120 yards of cover material were placed in the landfill.

On February 20, 1996, BSC filed a declaration in the Erie County Clerk's office limiting future use of the property around and including SWMU S-12. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction prevents the installation and operation of extraction or water wells for purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants and Restrictions is attached as Appendix B.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (US Army Corps) show that the dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-12. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI. The contribution of this particular SWMU to groundwater contamination is not known.

During the 1990s, the landfill was inspected several times. A June 1992 visual inspection conducted by BSC revealed that the site was in good condition, with no indication of exposure of the bags of asbestos. A 1996 inspection conducted by the consulting firm Dames & Moore again showed that the landfill was in good condition, with all stockpiled asbestos properly covered by slag fill. The inspection confirmed that, because the landfill was below the surrounding grade, there was no evidence of surface water runoff from the SWMU. A June 2000 inspection conducted by URS Corporation (URS) verified that no changes had occurred to the landfill in the four years following the last inspection. SWMU inspection field notes for the 1996 and 2000 inspections are included in Appendix C. Field records from BSC's June 1992 visual inspection are not available.

2.0 SAMPLING AND ANALYSIS

Soil gas and groundwater sampling was conducted in and near SWMU S-12 on three separate occasions. A soil gas survey was conducted in 1994. Groundwater sampling of two adjacent wells (MWN-29A and MWN-28A) were sampled in 1994 and 1999. All sampling was conducted in accordance with the Phase I Work Plan, the Quality Assurance Plan, the Comprehensive Well Sampling Plan and the Phase IIB Work Plan (BSC 1989; 1990; 1999a; 1993).

2.1 Soil Gas

In response to a USEPA request, this SWMU was investigated during Phase IIB of the RFI to evaluate the potential presence of organic compounds and hazardous materials, in addition to asbestos. Because deep ground-intrusive investigation methods would jeopardize the integrity of the covered unit and the underlying asbestos materials, a soil-gas survey (a shallow ground-intrusive technique) was conducted.

On July 13, 1994, four Petrex soil gas probes were installed on the site-three within the SWMU soil cover (S-12-1 through S-12-3) and one upgradient to collect background readings (S-12-4), as shown in Figure 1. The probes were installed to a depth of approximately 1.5 feet below the surface and allowed to remain in the soil for a period of two weeks. The probes were removed from the soil and submitted to Northeast Research Institute, Inc. (NERI) for analysis of total aromatic compounds, chlorinated compounds, oil, and naphthalene.

2.1.1 Soil Gas Results

Chlorinated compounds were not detected in any of the four soil gas probes. Positive results for oil, naphthalene, and aromatics, however, were detected in the samples. Soil gas survey results, presented in units of mass spectrometer ion counts, are provided in Appendix D. NERI's evaluation of the soil gas results revealed that the presence of soil gas is reflective of the presence of petroleum hydrocarbons in the groundwater. A copy of the data evaluation by NERI is provided in Appendix D. A discussion of groundwater quality is presented in the following section.

Soil gas survey results (ion counts) are qualitative and only represent the presence of a particular type of compound and not the relative concentration of that compound. Alkyl aromatics and oil-based parameters were detected in all four samples collected. Naphthalene compounds were detected in three of the four samples collected, including the background sample, S-12-4. Because the detected compounds were present in the background sample, the results reflect the facility-wide groundwater contamination issues and are not related to materials present in SWMU S-12. Due to the qualitative nature of the soil gas survey, groundwater is a more precise media to measure potential impacts from the landfill.

2.2 Groundwater

Two groundwater monitoring wells, one upgradient (MWN-29A) and one downgradient (MWN-28A) of SWMU S-12 were constructed during Phase IIC of the RFI (Figure 1). Following well completion, groundwater samples were collected on February 27, 1995 and again on November 5, 1999 and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and cyanide.

2.2.1 Groundwater Results

For the February 27, 1995 event, three VOCs (benzene, toluene and xylenes) were detected in the upgradient and downgradient wells. The concentrations of these VOCs were higher in the upgradient well, in two cases (benzene and toluene) by more than two times the downgradient level. Low concentrations of eight SVOCs were detected in both the upgradient and downgradient wells at essentially the same levels.

On November 5, 1999, groundwater was again sampled using an analytical suite similar to the 1995 sampling event. The analytical results were representative of the initial 1995 sampling results. Four VOCs (benzene, toluene, xylenes, and 1,1,1-trichloroethane) were detected in the upgradient well MWN-29A. There were no VOCs detected in the downgradient well MWN-28A. Concentrations of eight SVOCs were detected in both the upgradient and downgradient wells at essentially the same levels.

For both groundwater sampling events, the VOC concentrations were higher in the upgradient well than the downgradient well. The remaining analytes were present in similar concentrations for both the upgradient and downgradient wells. Based on the data, the landfill has not contributed to contaminants of concern detected in the groundwater. The analytes detected above practical quantitative limits (PQLs) in groundwater are attributable to an upgradient source(s) that was investigated as part of the RFI.

A summary of the site specific compounds of potential concern is provided in Table 1. Groundwater samples collected during the RFI program were analyzed for these compounds. Data Qualifiers follow Table 1. Table 2 is a summary of groundwater analytical results for both MWN-29A and MWN-28A and shows analytes with reported concentrations above the PQL for any sample collected from either well. The detected analyte concentrations are shown with their respective USEPA data qualifiers. Analytes that were not detected in either well for all sample events are not shown. Laboratory analytical reports are provided in Section II the RFI Report.

3.0 RISK ASSESSMENT

In accordance with the Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC 1998), SWMU S-12 was eliminated from quantitative analysis. This landfill has not experienced a release of hazardous constituents and is not likely to experience a release in the future. There is no available exposure pathway to direct human contact, or to groundwater, surface water or air. Therefore, further evaluation during the Corrective Measures Study (CMS) is not warranted.

4.0 CONTAINMENT

The landfill was excavated in an area of the SFA where molten slag was poured and allowed to cool. In accordance with the terms specified in NYSDEC Permit Number 2275, all of the material placed in the landfill was sealed in plastic bags and covered with several feet of slag. Figure 2 shows the general site layout. A copy of the NYSDEC permit is included in Appendix E.

The local groundwater table lies at an elevation of approximate elevation of 573 feet above msl. The bottom of the landfill is estimated to lie at an elevation of 578 feet above msl, providing a 5-foot separation between the stored materials and the local groundwater table.

Runoff from the landfill is prevented by 4-foot high berms on the west, south, and east side that surround the landfill. In addition, the top surface of the landfill cover is about 4 feet below grade. Because all of the asbestos is covered with a 2- to 3-foot layer of granular slag fill, there are no exposure pathways for ingestion, inhalation, or dermal contact.

Asbestos material is insoluble in water and, therefore, the only migration pathway of asbestos waste into the groundwater is by the release of fibers. Because plastic bags were used to contain the asbestos-containing material in the landfill, potential release of asbestos fibers into the groundwater is unlikely.

5.0 CONCLUSIONS

The investigations demonstrate that no releases of the specific hazardous constituents associated with the asbestos and asbestos-related materials to the environment have occurred as a result of NYSDEC–permitted landfilling operations at SWMU S-12. Based on the information summarized below, no further assessment is required.

- The asbestos landfill is a permitted facility that was constructed and operated solely for the purpose of disposing of bagged asbestos from BSC Lackawanna facility operations. The asbestos was managed in accordance with NYSDEC Permit No. 2278 requirements.

- A Declaration of Conditions, Covenants and Restrictions for the slag fill area, including SWMU S-12, was filed in 1996. The declaration limits future use of the property to industrial use and the restrictions also prevent the installation and operation of extraction or water wells for purposes other than environmental remediation use.

- Groundwater sampling results from the event conducted in 1995 and 1999 indicate that asbestos wastes placed in the landfill have not contributed to contaminants of concern detected in the groundwater and the hazardous compounds identified in upgradient and downgradient wells are not associated with the asbestos or asbestos-related materials placed in the landfill.

- Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (US Army Corp) show that the dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-12. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI.

- Since the asbestos material was disposed in sealed plastic bags, the downward migration of insoluble asbestos to the groundwater table is unlikely. Groundwater lies approximately 5 feet below the floor of the landfill. The landfill construction methods and the slag cover prevent exposure pathways via ingestion, inhalation, and dermal contact.

- The risk assessment did not identify any COPCs or complete exposure pathways that would present a risk to human health.

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SWMU ASSESSMENT REPORT
TAR SLUDGE SURFACE IMPOUNDMENT
(SWMU S-13)

BETHLEHEM STEEL CORPORATION
LACKAWANNA, NEW YORK

BETHLEHEM STEEL

SEPTEMBER 2004

BETHLEHEM STEEL CORPORATION
2600 HAMBURG TURNPIKE
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FIGURES
(Following Text)

Figure 1 Tar Sludge Surface Impoundment (SWMU S-13) Site Locations

Figure 2 Monitoring Well/Piezometer Location Map With Groundwater Elevation Contours (Fill Unit)

TABLES
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1.0 INTRODUCTION

This report documents the results of an environmental assessment of Tar Sludge Surface Impoundment at Bethlehem Steel Corporation's (BSC's) Lackawanna, New York facility. The Tar Sludge Surface Impoundment was identified as Solid Waste Management Unit (SWMU) S-13 in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (USEPA 1988) because it contains tar decanter sludge material generated during the coking process. SWMU S-13 is one of three SWMUs that are part of the Hazardous Waste Management Units (HWMUs) located at BSC's Lackawanna facility. The United States Environmental Protection Agency (USEPA) has required that a RCRA Facility Investigation (RFI) of this and other SWMUs at the BSC facility be completed in accordance with the Administrative Order of Consent (AOC) signed by BSC and USEPA in 1990 (USEPA 1990). The RFI has been conducted in several phases and included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. This report evaluates SWMU data available to BSC as of February 2002.

1.1 Description

SWMU S-13 is also known as HWMU-1A and is located north of Smokes Creek, along the southern edge of groundwater Zone 4 of the Lackawanna facility's Slag Fill Area (SFA) (Figure 1). HWMU-1B is located in SWMU S-16 and is evaluated in a separate report. SWMU S-13 is an irregularly shaped surface impoundment that is approximately 290 feet long and 160 feet wide. The unit is approximately 13 feet deep and rises approximately 8 feet above ground surface.

An estimated 5,600 cubic yards of tar decanter sludge, iron-making slag, coke fines, coal tar tank bottoms, and ammonia absorber acid tar is contained in SWMU S-13 to a maximum depth of approximately 13 feet below grade (bg) and a maximum height of approximately 1 foot bg. The unit is covered with a polyethylene cap, topsoil, and grass. The cap rises approximately 8 feet above the surrounding grade, providing a total cap thickness of 9 feet. Groundwater beneath the SWMU lies approximately 40 feet below ground surface, and approximately 26 feet below the bottom of the waste material. Stormwater runoff collection ditches that surround the closed impoundment flow into a low lying slag area south of the impoundment.

1.2 History

From 1978 to 1982, steel-making solid wastes (iron-making slag, coke fines, coal tar tank bottoms, and ammonia absorber acid oil) and tar decanter sludge were disposed of in SWMU S-13 under NYSDEC Permit Number 2206 (Title 6 of the New York Code of Rules and Regulations (NYCRR) Part 360). A copy of the permit is provided in Appendix A. Before placing the tar decanter sludge in the impoundment, the tar was mixed with slag. The stabilized tar/slag mixture was then deposited in a depression within SWMU S-13 where it solidified in place.

Tar decanter sludge is a byproduct of coke-making operations at the BSC Lackawanna facility. Coke, a raw ingredient in the production of steel, is manufactured by heating coal in an oven for a period of 17 to 72 hours. During this heating process, known as "coking," volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and moisture are driven from the coal in a gaseous form and the remaining individual coal particles form a coke mass. The coke oven gases, which are captured to prevent release to the atmosphere, are subsequently cooled producing coal tar. The tar decanter sludge, essentially a denser fraction of coal tar, separates from the coal tar by gravity and settles in tar decanters. Tar decanter sludge solidifies upon cooling to ambient temperature and resembles cured asphalt.

The tar decanter sludge meets, according to USEPA and NYSDEC, the definition of a RCRA hazardous waste from a specific source (decanter tank tar sludge from coking operations meets the definition of a K087 hazardous waste). Tar decanter sludge meets a RCRA hazardous waste since it contains polycyclic aromatic hydrocarbons (PAHs). Pursuant to a Consent Agreement entered into between BSC and the USEPA in August 1985, BSC agreed to submit closure and post-closure plans, and develop and implement a groundwater monitoring program for the HWMUs. A copy of the Consent Agreement, and the RCRA closure and post-closure plans are presented in Appendices B and C, respectively.

On September 24, 1987, the NYSDEC approved the closure plan and post-closure plan for SWMU S-13 (HWMU-1A). Construction specifications for the closure of SWMU S-13, based on the approved closure plan, were submitted to the NYSDEC in January 1988.

On August 1, 1988, closure began with grading the existing slag fill and subsequently placing an additional slag sub-base. The impoundment was graded to sufficiently raise the cap elevation to promote positive drainage of rainwater. After grading, a clay-filled perimeter trench was installed to provide a positive seal around the impoundment. The trench was excavated into the existing ground surface to a depth of 2 feet around the perimeter of the impoundment.

Once the slag had been properly graded, a cap of low permeable soil was installed above the compacted slag sub-base to minimize surface water infiltration into the impoundment. Soil test results for the low permeability soils are included in Appendix D.

A high-density polyethylene (HDPE) geomembrane was installed on top of the compacted soil. A 1.5-foot thick soil layer was installed on top of the HDPE geomembrane and finally an additional 6-inch thick layer of topsoil was installed on top of the first soil layer. The topsoil was seeded, fertilized, and mulched. Personnel from the NYSDEC observed the installation of the cap and inspected the HDPE geomembrane during installation. Closure was completed on October 14, 1988. The Closure Certification Report is presented in Appendix E.

On January 11, 1989, BSC filed a declaration at the Erie County Clerk's office restricting future use of the property around and including SWMU S-13 pursuant to the provisions of 6 NYCRR Part 373-3.7. On January 23, 1989, the NYSDEC accepted the closure of SWMU S-13 and agreed that closure had been implemented in accordance with applicable regulations and procedures. A copy of the declaration and NYSDEC closure approval are attached as Appendix F.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (USACE) show that dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-13. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI. Because of the presence of the USACE dredge spoils, the contribution of this particular SWMU to groundwater contamination within the sand unit is not known.

During the 1990s, the impoundment was inspected several times. A June 1992 visual inspection conducted by BSC revealed that the site was in good condition, with no indication of exposure of the HDPE geomembrane. A September 1996 inspection conducted by the consulting firm Dames & Moore again showed that the cap over the impoundment was in good condition and confirmed that surface water was properly draining away from the impoundment. A July 18, 2000 inspection conducted by URS Corporation (URS) verified that no changes had occurred to the impoundment in the four years since the last inspection. Copies of the September 1996 and July 2000 inspections are provided in Appendix G. No records for the 1992 BSC inspection are available.

On February 20, 1996, BSC filed an additional declaration in the Erie County Clerk's office limiting future use of the slag fill area around and including SWMU S-13. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevents the installation and operation of extraction or water wells for purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants, and Restrictions (Deed Restriction) is attached in Attachment A.

2.0 SAMPLING AND ANALYSIS

As required by the RCRA closure plan and post-closure plan for SWMU S-13, three downgradient monitoring wells (MW-1D2, MW-1D3, and MW-1D4) and one upgradient well (MW-1U1) were installed for SWMU S-13 (Figure 2). Groundwater sampling is conducted on the four wells as part of the HWMU monitoring program on a quarterly and currently, semi annual basis. Because of the nature of the impermeable cap, no waste material was sampled during the RFI.

As part of the RFI, downgradient well MW-1D5 and upgradient wells MWN-13A, MWN-13B and MWN-13C were installed. MWN-13B was abandoned in July 1994. Well MW-1D2, MW-1D3, MW-1D4, MW-1D5, MW-1U1 and MWN-13A monitor groundwater quality within the slag fill unit. Well MWN-13C (located adjacent to MWN-13A) is screened within the sand unit. Because no downgradient well associated with SWMU S-13 is screened within the sand unit, the analytical data from MWN-13C was not used for groundwater quality assessment purposes. Groundwater contours for the fill unit are presented on Figure 2.

2.1 <u>Groundwater Sampling</u>

To assess the groundwater conditions beneath SWMU S-13, groundwater analytical results from four downgradient wells (MW-1D2, MW-1D3, MW-1D4, and MW-1D5) and two upgradient wells (MW-1U1, and MWN-13A) were reviewed. Although MW-1D2, MW-1D3, MW-1D4 and MW-1U1 have been sampled regularly as part of the HWMU monitoring program, all seven wells have been sampled sporadically as part of the RFI program. All groundwater sampling was conducted in accordance with the Groundwater Quality Assessment Plan (BSC 1987), Data Quality Assurance Plan (BSC 1989), Phase I Work Plan (BSC 1990), the Phase IIB Work Plan (BSC 1993), the Phase IIC Work Plan (BSC 1994b), the Groundwater Monitoring Sampling and Analysis Plan (HWMU-1 and HWMU-2) (BSC 1994a), the Natural Attenuation Phase 2 Study Work Plan (BSC 1997) and the Comprehensive Well Sampling Plan (BSC 1999a). A complete list of the site-specific compounds targeted for analysis in the RFI site investigations is provided in Table 1. USEPA data qualifiers are presented following Table 1.

2.2 HWMU Monitoring Program Groundwater Results

As part of the HWMU Monitoring Program, wells MW-1D2, MW-1D3, MW-1D4 and MW-1U1 have been sampled semi-annually since 1986. Analytical data for detected analytes from all sampling events is presented in Appendix I.

Due to the large amount of data, a trend analysis using the Mann-Kendall Nonparametric Test for Data Trends was utilized to determine which compounds, if any, exhibited an upward, downward, or no trend scenarios. The Mann-Kendall method determines the best-fit line for the slope of data to determine if concentrations are increasing, decreasing or no change is occurring over time. The statistical summary is presented on Table 2. A summary of compounds that exhibit a trend in one or more wells are presented below:

Compound/Metal	MW-1D2	MW-1D3	MW-1D4	MW-1U1
Benzene	Downward	Downward	Downward	Downward
Ethylbenzene	Downward	No Trend	No Trend	No Trend
Styrene	Upward	No Trend	No Trend	No Trend
Toluene	Downward	Downward	Downward	Downward
Total Xylenes	Downward	Downward	Downward	Downward
Acenaphthylene	No Trend	No Trend	Downward	Upward
Bis(2-Ethylhexyl)phthalate	No Trend	No Trend	Downward	No Trend
Fluoranthene	No Trend	Upward	Upward	Upward
Fluorene	No Trend	No Trend	No Trend	Upward
3-Methylphenol & 4-Methylphenol	No Trend	Downward	Downward	Downward
2-Methylphenol	No Trend	Downward	No Trend	No Trend
4-Methylphenol	No Trend	Downward	Downward	No Trend
Naphthalene	Downward	Downward	Downward	Downward
Phenanthrene	No Trend	No Trend	No Trend	No Trend
Phenol	No Trend	Downward	Downward	Downward
Pyrene	No Trend	No Trend	No Trend	Upward
Pyridine	Upward	No Trend	No Trend	No Trend
Arsenic	No Trend	No Trend	Upward	No Trend
Calcium	Downward	No Trend	No Trend	No Trend
Chromium	Upward	Upward	Upward	Upward
Selenium	Upward	Upward	Upward	Upward
Sodium	Upward	No Trend	Upward	No Trend
Potassium	No Trend	No Trend	No Trend	Downward
Arsenic-Dissolved	No Trend	Upward	No Trend	No Trend
Barium-Dissolved	No Trend	Upward	Upward	Upward

Compound/Metal	MW-1D2	MW-1D3	MW-1D4	MW-1U1
Magnesium-Dissolved	No Trend	No Trend	No Trend	Upward
Potassium-Dissolved	No Trend	No Trend	Downward	Downward
Selenium-Dissolved	Upward	Upward	Upward	No Trend
Sodium-Dissolved	Upward	No Trend	No Trend	No Trend
Chloride	Downward	Downward	Downward	Upward
Sulfate	Downward	Downward	Downward	Upward

As the table shows, sixteen compounds show an upward trend in concentration over time. Of those sixteen compounds, five (pyridine, sodium, arsenic, dissolved selenium and dissolved sodium) showed a trend in the downgradient wells and not in the upgradient well. Six other compounds (acenaphthylene, fluorene, pyrene, dissolved magnesium, chloride and sulfate) showed only an upward trend for the upgradient well.

Six compounds exhibited a common trend in all four wells. Benzene, toluene, total xylenes and naphthalene exhibited a downward trend. Chromium and selenium exhibited an upward trend.

Of the compounds that would most directly be associated with the tar decanter sludge stored within the SWMU; VOCs and SVOCs, only five (acenaphthylene, fluoranthene, fluorene, pyridine and pyrene) showed an upward trend in concentrations. Four of the five compounds showed an upward trend in the upgradient well and only two of the five showed an upward trend in at least one downgradient well. One compound, pyridine, showed an upward trend only in a downgradient well. The remaining detected VOCs and SVOCs showed either a downward trend or no trend.

2.3 1999 RFI Groundwater Results

In order to evaluate the current groundwater quality in all seven surrounding wells, the most recent facility wide sampling event (November 1999) was used. In 1999, all seven wells were sampled during the same event.

Tables 3 and 4 are a summary of detected analytes in groundwater from the November 1999 sampling event for upgradient and downgradient wells, respectively. The tables present concentrations reported above the practical quantitative limits (PQL). Analytes that were not detected are not shown. Laboratory analytical reports are provided in Section II of the RFI. Appendix H of this report presents a summary of groundwater analytical results for all seven wells for all sampling events. The appendix presents detected analytes reported at concentrations above the PQL.

As presented in Table 3, the November 1999 analytical results indicate VOCs, SVOCs, and metals are present in upgradient well MW-1U1. No VOCs were detected in upgradient well MWN-13A; however, SVOCs and metals were present. The three VOCs (benzene, toluene, and total xylenes) detected in MW- 1U1 ranged in concentration from 13 micrograms per liter (μg/L) for toluene to 74 μg/L for benzene. Of the eight SVOCs detected in MW-1U1, three (phenol, naphthalene and phenanthrene) were also found in MWN-13A. The concentrations were higher in MW-1U1. In addition, phenol was detected in MWN-13A at a concentration of 6.3 μg/L; however, the compound was not detected in MW-1U1. Twelve metals were detected in the upgradient wells and ranged from 1.1 μg/L of cadmium in MWN-13A to 256,000 μg/L of calcium in MW-1U1. In general, the same metal compounds detected in both wells (which included arsenic, barium, calcium, chromium, iron, magnesium, potassium, selenium, and sodium) were present in higher concentrations in well MWN-13A. Due to low turbidity, the samples were not analyzed for dissolved metals. In addition, chloride and sulfate were detected in both wells. Cyanide was detected in MW-1U1 only at a concentration of 0.17 mg/L.

Three VOCs (benzene, toluene, and total xylenes) were detected in all four downgradient wells (MW-1D2, MW-1D3, MW-1D4 and MW-1D5). The concentrations between wells ranged from 2.3 μg/L (benzene) to 32 μg/L (total xylenes), both from well MW-1D2. These concentrations were less than in the upgradient well MW-1U1. Of the thirteen SVOCs detected in the downgradient wells, the following six compounds were observed in all four downgradient wells: acenaphthylene, fluoranthene, fluorene, naphthalene, phenanthrene, and phenol. The SVOC concentrations ranged from 1.6 μg/L for fluoranthene (MW-1D4) to 340 μg/L for naphthalene (MW-1D2). With the exception of fluoranthene and pyrene, the highest concentrations were found in the downgradient wells.

Of the nine metals detected in the downgradient wells, six metals were detected in all four wells. These included barium, calcium, iron, potassium, selenium, and sodium. The concentrations ranged from 6.8 μg/L for selenium to 246,000 μg/L for calcium (both from well MW-1D2). Additional metals present but not detected in all four wells included chromium, magnesium, and mercury. The concentrations of these metals ranged from 0.084 μg/L for mercury (MW-1D3) to 118 μg/L for magnesium (MW-1D5). Due to the low turbidity of the groundwater samples (< 10 NTU); samples were not collected for dissolved metals analysis. Cyanide was only found in well MW-1D5, at a concentration of 0.066 mg/L. A summary of detected constituents for downgradient wells is presented on Table 4.

2.4 Summary of Groundwater Analytical Results

Of the twenty-five compounds regularly detected in the semi-annual groundwater monitoring program, sixteen show an upward trend (using the Mann-Kendall Nonparametric Test for Trend). Of those sixteen compounds, only five compounds showed a trend in the downgradient wells and not in the upgradient well and only one of the five compounds (pyridine) was not a metal. In addition, of those sixteen compounds with an upward concentration trend, only five organic compounds (VOCs/SVOCs) were identified. Of those five organic compounds, only two (ethylbenzene and fluoranthene) showed an upward trend in a downgradient well, as well as an upgradient well.

The RFI 1999 facility-wide sampling event indicated VOC concentrations were higher in upgradient well MW-1U1 compared to the four downgradient wells (no VOCs were detected in the second upgradient well MW-13A). The SVOC concentrations were generally higher in the downgradient wells. With the exception of barium, mercury and selenium, the highest concentrations of total metals were detected in the upgradient wells.

Although VOCs and SVOCs were detected in the downgradient wells, and SVOC concentrations were generally higher in the downgradient wells, the trend analysis of the quarterly/semiannual groundwater-sampling program shows that a majority of the VOC and SVOC concentrations have remained static or trended downward. This suggests that the construction of the impermeable cap in the late 1980s is likely preventing further leaching of the SWMU-related constituents into the fill unit.

As noted in Section 1.2, historical documents obtained from regulatory agencies, including the USACE show that dredge spoils were disposed off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-13. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zones 3, 4 and 5, is further assessed in the RFI. Because of USACE dredge spoils, the contribution of this particular SWMU to groundwater contamination (if any) within the sand unit is not known.

3.0 QUALITATIVE RISK ASSESSMENT SUMMARY

In accordance with ID No. 1 (BSC 1998), SWMU S-13 (also known as HWMU 1A) has been eliminated from quantitative analysis in the risk assessment. Under a NYSDEC-approved closure plan, in 1987, SWMU S-13 was closed and capped as a hazardous waste impoundment, and deed restrictions were implemented to restrict future use on and around the site. This SWMU is currently monitored under a NYSDEC-approved post-closure plan.

From 1978 to 1982, SWMU S-13 was used to dispose several non-hazardous wastes including iron-making slag, coke fines, coal tar tank bottoms and ammonia absorber acid-oil. Coal tar sludge, or decanter sludge, is the only listed hazardous waste disposed of in S-13. BSC does not have data from the surface impoundment that meet the criteria established for data to be used in a risk assessment, and the available waste characterization data relevant to S-13 are for coal tar sludge (primarily Toxicity Characteristic Leaching Procedure analyses); however, less than 1% of the material in S-13 is believed to be coal tar sludge. Because data are not available for the SWMU itself, COPC selection could not be performed for this unit.

The potential for exposure to constituents in groundwater (*e.g.*, inhalation of volatiles) are not specifically applicable to this SWMU, as potential receptor populations are restricted access to and near this SWMU.

It is unlikely that the material in S-13 is capable of posing a substantial present or future hazard to human health. With such a small amount of the waste in S-13 being derived from hazardous waste, completed closure (including the installation of a permanent non-permeable cap under the close supervision of NYSDEC), and deed restrictions on future use, potential threat associated with human health (*e.g,*, direct contact with SWMU material) has been removed (to the extent such a threat ever existed). Further, BSC continues to comply with post-closure care requirements for S-13. Therefore, as BSC continues to comply with these requirements, it is not believed that S-13 poses a current or future threat to human health.

4.0 CONTAINMENT

The surface impoundment was excavated in an area of the SFA where molten slag was poured and allowed to cool. The molten slag produced an extremely dense aggregate. All of the material placed in the surface impoundment was solidified with slag material. The waste material was subsequently covered with a cap of low permeable soil and an HDPE geomembrane cover. The HDPE cover was capped with a low permeable soil and topsoil. The topsoil was seeded, fertilized, and mulched. The cap prevents percolation of rainwater into the surface impoundment. Runoff collection ditches that surround the unit prevent the ponding of rainwater at the base of the SWMU. Runoff from the capped impoundment flows to the south into a slag sump, where it eventually evaporates or infiltrates the slag surface.

5.0 CONCLUSIONS

Based on review of the data, the following conclusions can be made:

- Prior to 1982, solid wastes including iron-making slag, coke fines, coal tar tank bottoms, and ammonia absorber acid oil, were co-disposed with tar decanter sludge in SWMU S-13.

- SWMU S-13 was closed in the fall of 1988 in accordance with the Consent Agreement and applicable New York and federal closure requirements for a landfill containing RCRA hazardous wastes. The surface impoundment was covered with a polyethylene geomembrane cap, and runoff and diversion ditches were installed around the surface impoundment. On January 11, 1989 a restrictive covenant was placed on SWMU S-13 by BSC and restricted future use of the property around and including SWMU S-13 pursuant to the provisions of 6 NYCRR Part 373-3.7.

- On January 24, 1989, the NYSDEC accepted the closure of SWMU S-13 and agreed that closure had been implemented in accordance with applicable regulations and procedures. Groundwater monitoring in support of the impoundment closure requirements is currently conducted on a semi-annual basis.

- The statistical trend analysis showed that of the twenty-five compounds regularly detected in the quarterly/semi-annual groundwater-monitoring program, only sixteen show an upward trend. Of those sixteen compounds, only five compounds showed a trend in downgradient wells and not in the upgradient well. Only one of the five compounds (pyridine) was not a metal. In addition, of those sixteen compounds with an upward concentration trend, only five VOCs/SVOCs were identified. Of those five organic compounds, only two (ethylbenzene and fluoranthene) showed and upward trend in a downgradient well as well as in the upgradient well.

- The RFI 1999 facility-wide sampling event indicated VOC concentrations were higher in upgradient MW-1U1 compared to the four-downgradient wells. The SVOC concentrations were generally higher in the downgradient wells. The total metals concentrations were generally higher in the upgradient wells.

- Although VOCs and SVOCs were detected in the downgradient wells, and SVOC concentrations were generally higher in the downgradient wells, the trend analysis of the semiannual groundwater sampling program shows that a majority of the VOC and SVOC concentrations have remained static or trended downward. This indicates the construction of the impermeable cap in the late 1980s is preventing further leaching of the waste material into the fill unit groundwater.

- Historical documents obtained from regulatory agencies, including the USACE show that dredge spoils were disposed of at the BSC Lackawanna facility shoreline from 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMUS-13. The potential impact to groundwater beneath the site especially in the sand unit in the groundwater Zones 3, 4 and 5 is further assessed in the RFI. Because of USACE dredge spoils, the contribution of this particular SWMU to groundwater contamination on (if any) within the sand unit is not known.

- Based on the limited exposure pathways (i.e. the SWMU is capped with an impermeable liner), the qualitative HHRA, determined that the material in SWMU S-13 is unlikely to pose a substantial present or future hazard to human health.

Because of the engineered closure of the landfill, pursuant to NYSDEC regulations, the results of the semi-annual groundwater monitoring program and the results of the qualitative HHRA, no further assessment of this SWMU is warranted.

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SWMU ASSESSMENT REPORT
GENERAL RUBBLE LANDFILL N
(SWMU S-14)

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SEPTEMBER 2004

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FIGURES
(Following Text)

Figure 1	Site Location Map Showing Sample Locations for: General Rubble Landfill N (SWMU S-14)
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1.0 INTRODUCTION

This report documents the results of an environmental assessment of General Rubble Landfill N, at the Bethlehem Steel Corporation (BSC) facility in Lackawanna, New York. General Rubble Landfill N was designated Solid Waste Management Unit (SWMU) S-14 in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (USEPA, 1988) as an area used to dispose of discarded material from plant operations. The United States Environmental Protection Agency (USEPA) has required that a RCRA Facility Investigation (RFI) of this and other SWMUs at the BSC facility be completed in accordance with the Administrative Order on Consent (AOC) signed by BSC and USEPA in 1990 (USEPA, 1990). The RFI has been conducted in phases (Phases I, IIA, IIB, IIC, and III), and included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. A preliminary SWMU assessment was completed for SWMU S-14 and submitted to the USEPA on January 5, 1993. Attachment A provides USEPA comments regarding the Preliminary SWMU Assessment. This report evaluates SWMU data available to BSC as of November 2001.

1.1 Description

SWMU S-14 is located in the northwestern portion of Zone 4 of the Slag Fill Area. It is north of Smokes Creek, on the west side of BSC Highway 11 and immediately north of SWMU S-23. (Figure 1). SWMU S-14 is a heavily vegetated mound of brown, fine- to coarse-grained sand and gravel-like material containing a variety of debris including scrap metal, construction materials (concrete, bricks, plastic pipe) wood, slag, and glass. The vegetation consisting of small brush and trees is concentrated on the top of the mound, while the steeply sloped sides (60° to 90°) are approximately 50% covered with vegetation. SWMU S-14 is roughly oval in shape, approximately 450 feet long at the base, 300 feet long at the top, 130 feet wide, and 40 feet high. The estimated volume is 57,000 cubic yards and it covers an approximate surface area of one acre. The base of the unit rests on approximately 50 feet of slag fill. Although there are no wells located within or immediately adjacent to SWMU S-14, groundwater data from proximate wells (upgradient) indicated groundwater was generally encountered at 574 feet above mean sea level (approximately 50 feet below the base of the SWMU).

1.2 History

SWMU S-14 is believed to contain mostly slag material from steel production. As seen in the boring logs in Appendix B, slag fill was consistently encountered throughout the entire subsurface profile that was investigated. The slag was placed in this unit for storage prior to the reclamation of metallics. The greatest production of "general rubble" was from the pit areas of the open-hearth steel making shops. Such rubble consisted of slag and some steel, both of which would have accumulated in the pits in the molten state. In addition, brick rubble from the cleaning of the slag pockets of the open hearth furnaces, scrap billets from the bar mills, and steel and iron buttons from the bottoms of slag pots were normally mixed with other materials in the pits. The material that collected in the pits was periodically removed and transported to SWMU S-14 via rail cars or off-road trucks. Placement and recovery of materials continued up until the shutdown of steel-making operations in 1983. SWMU S-14 presently is inactive and there are no plans for further activity at this unit.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (US Army Corps) show that the dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the slag fill area (SFA), including the area immediately under SWMU S-14. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI. The contribution of this particular SWMU to groundwater contamination is not known.

On February 20, 1996, BSC filed a declaration in the Erie County, N.Y. Clerk's office limiting future use of the property around and including SWMU S-14. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevents installation and operation of extraction or water wells for purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants and Restrictions is provided as Attachment B.

An inspection of SWMU S-14 was conducted by Dames & Moore in September 1995 and in September 1996. During these inspections, the unit appeared to contain only debris from steel-making operations. An additional inspection was performed by URS in September 2000. All inspections found the site as described in Sections 1.1 and 4.0. The field notes for the 1996 and 2000 SWMU inspections are provided in Appendix A. The 1995 inspection notes are not available.

2.0 SAMPLING AND ANALYSIS

Soil samples were collected from the material contained in SWMU S-14 on two separate occasions. Near-surface grab samples were obtained in February 1995, and subsurface samples were obtained in September 1995. Sampling was conducted in accordance with the Quality Assurance Plan, Phase IIC Work Plan, and the Sampling Analysis and Testing Module, Phased Site Investigation (Phase III) (BSC 1989, 1994, 1995). A complete list of site-specific compounds targeted for analysis in the site investigations is provided in Table 1. Sample records and boring logs are included in Appendix B. Laboratory analytical reports are provided in Section II of the RFI.

There are no downgradient wells for SWMU S-14. Due to a localized groundwater mound beneath SWMU S-23, one monitoring well MW-1D8 is upgradient to a portion of SWMU-S-14. The remainder of the wells that are near SWMU S-14 (e.g., MW-1D7) are crossgradient or generally not considered applicable to this waste management unit. Therefore, a groundwater analytical data table was not generated for this unit. Groundwater elevation contour maps are provided in Figures 2 and 3.

2.1 Soil Samples

In response to a USEPA request (Attachment A), this SWMU was investigated during Phase IIC of the RFI to evaluate the presence of hazardous materials. In February 1995, four discrete surface samples were collected from SWMU-14. The samples were obtained from the 0- to 6-inch interval at the sample locations (S14-1 through S14-4) shown in Figure 1. The samples were described as brown, fine- to coarse-grained sand and gravel-like material, with some silt, cinders, glass debris, and half-inch diameter steel pellets. The samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and cyanide. Analyses included Total Constituent Analysis, Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) analysis for VOCs, SVOCs, metals, and cyanide.

During a Phase III investigation in September 1995, two borings (S-14-1C and S-14-2C) were drilled at SWMU S-14. Samples were obtained from continuous split–spoon sampling. Composite samples were collected from each boring [S-14-1C (0-15.8 feet); S-14-2C (0-30.0 feet)] for analysis of SVOCs and metals. Additionally, one grab sample for VOC analysis was collected [S-14-1G (6.0-8.0 feet) and S-14-2G (4.0-6.0 feet)] from the sampling interval in each boring having the highest levels of volatile organics as measured by field screening methodologies.

2.1.1 Total Constituent Results

The 1995 analysis of the four surface grab samples, as well as the two grab and associated composite subsurface samples obtained from the borings revealed the presence of several VOCs, SVOCs, metals, and cyanide. Detected analytes are summarized in Table 2. Analysis of the September 1995 samples from the borings indicated trace levels of several VOCs; however, a significant number of results were flagged as estimated values due to internal standard failure. Numerous SVOCs were detected in both composite subsurface samples. The highest concentrations of SVOCs were found in sample S14-1C (0-15.8 feet). Concentrations of SVOCs in S14-1C ranged from a low of 57 micrograms per kilogram (ug/kg) of 2-methylphenol to 1,400,000 ug/kg of naphthalene. A total of 19 SVOCs were detected in sample S14-1C and 16 SVOCs were detected in sample S14-2C (0-30.0 feet). Nine metals were detected in both composite subsurface samples. Although fairly consistent, the highest concentrations were generally present in sample S14-2C. Concentrations in S14-2C ranged from 0.135 milligrams per kilogram (mg/kg) of mercury to 225.5 mg/kg of lead.

2.1.2 TCLP Results

TCLP results were compared to regulatory concentration levels listed in 40 CFR Part 261. The TCLP extract concentration indicates that the material in the General Rubble Landfill N (SWMU S-14) does not meet TCLP criteria.

SWMU S-14 TCLP analytical results are summarized in Table 3.

2.1.3 SPLP Results

SPLP analyses were conducted to more closely mimic the effect of compounds leaching from the soil due to rainwater infiltration. The analyses were performed in accordance with the USEPA's SW846 Method 1312 protocols. The SPLP results help evaluate what compounds can potentially leach from the soils into the subsurface.

Analyses of the February 1995 surficial grab samples indicate lead and chromium concentrations were above detectable levels. With exception of methylene chloride in surface samples S14-3 and S14-4, no other compounds, including VOCs and SVOCs were detected in the surface grab samples.

Analysis of September 1995 subsurface samples from the borings indicated that several VOCs, SVOCs, and metals were detected above method detection limits. Of the two composite subsurface samples, SVOCs and metals were only detected in S14-1C. The 10 SVOCs detected ranged from 0.006 milligrams per liter (mg/L) of 2-methylphenol to 15.0 mg/L of naphthalene. The three metals detected in S14-1C ranged in concentration from 0.006 mg/L of antimony and selenium to 0.049 mg/L of barium.

Several VOCs were detected in both grab samples S14-1G (6.0-8.0 feet) and S14-2G (4.0-6.0 feet). Although concentrations of VOCs are similar, the highest concentrations were generally present in S14-1G. Of the five VOCs detected in both samples, (benzene, ethylbenzene, toluene, xylenes and methylene chloride), the concentrations ranged from 0.007 mg/L of ethylbenzene to 0.2 mg/L of xylenes.

SPLP results are summarized in Table 2.

2.2 Groundwater

Historical documents obtained from regulatory agencies show that the dredge spoils from the U.S. Army Corps, were deposited off the BSC shoreline in the late 1930's to the late 1940's. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-14. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI. The contribution of this particular SWMU to groundwater is not known.

2.3 Summary of Sampling Results

The TCLP extract concentration indicates that the materials in SWMU S-14 material do not meet TCLP criteria.

Total constituent analysis shows concentrations of VOCs, SVOCs and metal are present in the SWMU surface material.

Constituents detected in the SPLP leachate were consistent with those detected in the total constituent analysis.

Further evaluation of the compounds detected in the SWMU material will be presented in Section 3.0 (Risk Assessment).

3.0 RISK ASSESSMENT

A human health risk assessment, as described in the *Human Health Risk Assessment Work Plan*, (BSC 1997), was conducted for SWMU S-14, General Rubble Landfill N. The results of the Tier 1 Human Health Risk Assessment (HHRA) are presented here and are organized into the following sections: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization and Uncertainty Analysis. The major components of this HHRA have previously been presented in Human Health Risk Assessment Report, Part IV of this RFI Report. Therefore, the following sections provide summary overviews of previously presented information. This section, therefore, serves as a summary report, bringing together all associated and related work from previous risk assessment deliverables, and providing the conclusions of the SWMU-specific risk assessment.

3.1 Data Evaluation

A list of 96 constituents of potential interest (COPIs) was developed for the BSC Lackawanna, New York facility based on USEPA and industry studies (BSC 1998). The list contains hazardous constituents that could be present in the waste streams as a result of integrated iron and steel plant operations, such as those historically conducted at the Lackawanna facility. Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC 1998) established the chemicals of potential concern (COPCs) for each SWMU at the Lackawanna Facility. The COPCs were determined by sequentially applying the following criteria, as applicable, to each COPI on a medium by medium basis for each SWMU: 1) the chemical was detected in at least 5% of the samples, 2) the chemical was detected in at least one sample at levels above background (*i.e.*, the maximum concentration was above background; for chemicals in surficial SWMU material only) and 3) the chemical was positively detected in at least one sample at levels above applicable screening criteria [*i.e.*, the maximum concentration was greater than the screening criteria: USEPA Region III Risk Based Concentrations (RBCs), USEPA Soil Screening Levels (SSLs), or NYSDEC Ambient Water Quality Standards and Guidance values]. In accordance with ID No. 1, a background comparison was not made for the subsurface SWMU material in this report.

The sampling data for SWMU S-14 (as presented in Section 2.0 of this report) were evaluated in order to identify the site-related COPCs for the SWMU. COPCs were originally determined in ID No. 1, however, as some screening criteria were reviewed since ID No. 1 was submitted, the screening process was updated (Tables 4 through 6). Table 4 presents the screening of the surficial SWMU material, Table 5 presents the screening of the subsurface SWMU material, and Table 6 presents the screening of groundwater. Two inorganic COPCs (antimony and lead) and no organic COPCs were identified in surficial SWMU material. One inorganic (arsenic) and twelve organic COPCs (mostly PAHs) were identified in subsurface SWMU material, and fourteen volatile organic COPCs were identified in groundwater. Representative concentrations were then determined for each COPC; these representative concentrations are presented in Table 7. If the sample size for a dataset was ten or greater, the 95% upper confidence limit of the mean was used as the representative concentration. For those datasets with sample sizes of less than ten, the maximum detected concentration was used. Four surface soil samples and two subsurface soil samples were collected for SWMU S-14; therefore, the maximum concentration was used to represent all COPCs in SWMU material. SWMU S-14 is located in Groundwater Zone 4 (BSC 1998). As more than ten groundwater samples have been collected, the 95% UCL was used as the representative concentration for each of the COPCs. If a chemical's representative concentration exceeds its saturation limit in soil, or its solubility limit in groundwater, this is noted in Table 7. Exceedances of either of these levels may indicate the presence of free product. The COPCs and their representative concentrations are presented in Table 7; these concentrations are used in the SWMU S-14 risk characterization.

3.2 Exposure Assessment

The exposure assessment conducted for SWMU S-14 included a review of current and future human receptor scenarios and potential exposure pathways, as related to COPCs. In general, exposure pathways by which a human receptor could come into contact with SWMU material are defined by four components (USEPA 1989):

- A source and mechanism of constituent release to the environment;
- An environmental transport mechanism;
- A point of potential human contact with the affected medium, and
- A route of entry into humans.

If any one of these components is missing, the pathway is considered incomplete and does not contribute to receptor exposure.

Human Health Risk Assessment ID No. 2 (BSC 1999) presented the current and future human receptor scenarios and potentially complete exposure pathways for each of the SWMUs identified at the Lackawanna Facility. ID No. 1 (BSC 1998) identifies the COPCs; these COPCs were also integral in determining complete exposure pathways, based on their presence in each medium (*i.e.*, surface SWMU material, subsurface SWMU material or groundwater) and their volatility (*e.g.*, inorganics in groundwater do not present a complete inhalation exposure pathway as they are not volatile and groundwater is not used as a drinking water source). Potential exposure pathways for S-14 are presented in Table 8 and below.

For SWMU S-14, the potential receptor scenarios include a current non-BSC commercial/industrial worker, a future commercial/industrial worker, a future construction worker, a future utility/maintenance worker, a trespasser, a future marina worker, a future greenway user, a future fenceline resident, and a present fenceline resident. Potentially complete exposure pathways were previously established in ID No. 2 for each receptor and are summarized below. Scenarios were developed based on current use patterns, unrestricted future commercial/industrial development, and potential future recreation uses.

For the future commercial/industrial worker scenario, the future utility/maintenance worker scenario, the future construction worker scenario and the trespasser scenario, the following pathways were determined to be complete: direct contact (*i.e.*, ingestion or dermal contact) with surface SWMU material, inhalation of airborne particulates from surface SWMU material, inhalation of vapors from subsurface SWMU material and inhalation of vapors from Groundwater Zone 4. The future commercial/industrial worker scenario may also be potentially exposed to indoor vapors from groundwater or subsurface SWMU material, should a building be placed on SWMU S-14 under current conditions.

The future construction worker scenario and future utility/maintenance worker scenario may additionally be exposed via direct contact with subsurface SWMU material (ingestion, dermal contact, vapor and particulate inhalation) during potential future digging activities. Potentially complete exposure pathways for the current non-BSC scenario, and present and future residential scenario, include inhalation of particulates in surficial SWMU material and inhalation of vapors in subsurface SWMU material. A detailed description of the potentially exposed receptor scenarios and pathways for SWMU S-14 can be found in ID No. 2 (BSC 1999) and a summary is provided in Table 8.

3.3 Toxicity Assessment

A toxicity assessment characterizes the relationship between the exposure to a COPC and the frequency of adverse health effects that may result from such an exposure (dose-response). The end result of the dose-response assessment is the determination of human uptake levels that provide an adequate measure of protection to exposed persons for carcinogenic and noncarcinogenic endpoints. The derivation of acceptable levels of exposure (*e.g.*, risk-based screening levels; RBSLs) and the manner in which these levels are used in this HHRA are discussed below.

Tier 1 RBSLs were calculated and compared to the representative SWMU S-14 COPC concentrations. RBSLs are defined as concentrations of COPCs in media that are not expected to produce any adverse health effects under assumed exposure conditions. Tier 1 RBSLs were developed using information previously defined and described in detail in the Work Plan and ID No. 2. This information is summarized here. The equations used to calculate the RBSLs follow basic USEPA risk assessment principles (USEPA 1989; 1996). Conservative exposure parameters, as defined by the ASTM Standard (ASTM 1995) and USEPA guidance (USEPA 1989, 1991a and 1991b), and USEPA toxicity criteria (USEPA 2001) were inputs into these equations to develop the RBSLs. As some of the toxicity criteria have been revised by the USEPA since originally presented in ID No. 1, the criteria for all chemicals have been re-presented in Table 9 of this HHRA. The above information was used to calculate Tier 1 RBSLs for COPCs in SWMU material and groundwater for each of the nine receptor scenarios.

For this risk assessment, vapor dispersion modeling was performed to enable estimation of potential exposure to airborne COPCs emanating from subsurface SWMU material. Modeling was performed with the USEPA Industrial Source Complex Short-Term Model (ISCST3, version 99155) and with meteorological data collected at a monitoring station at the Lackawanna facility in 1991. For current the non-BSC worker scenario, Tier 1 RBSLs were calculated based on the maximum estimated impacts in the northern, middle, and southern regions of the facility. For this Tier 1 assessment, the most conservative RBSL (*i.e.*, lowest) of the regions was used to represent the current non-BSC worker scenario. Particle dispersion modeling was not performed for Tier 1 RBSLs; instead, it was conservatively assumed that the receptor is actually present on the SWMU.

It should be noted that, in groundwater, many of the RBSLs calculated were greater than the chemicals' solubility in water. This indicates that, based on the predicted amount of chemical volatilization, pure product in the groundwater would not pose an inhalation health threat from these chemicals. The solubility limits of these chemicals are indicated in Table 10.

Similarly, some of the RBSLs calculated for the COPCs in subsurface SWMU material may have been determined to be health protective at concentrations that are greater than the chemicals' saturation limit in soils. However, it is important to consider that chemical emissions from soil to air reach a plateau at the chemical's saturation limit, and volatile emissions will not increase above this level, regardless of how much more chemical is added to the soil. In other words, the exposure concentration for an inhalation-only scenario cannot exceed a chemical's saturation limit. Furthermore, RBSLs that are above the saturation limit are not likely to pose increased risks or hazards (USEPA 1996). Therefore, RBSLs that are based only upon the inhalation pathway are capped at the saturation limit for that chemical, and "> sat limit" is indicated in such situations (Table 10). Other RBSLs that are not based solely on inhalation were not capped at the saturation limit, as the potential exposure concentrations are greater than the saturation limit for direct contact scenarios (*e.g.*, dermal contact, ingestion).

Lastly, some of the RBSLs for COPCs in SWMU material were determined to be health protective at levels that are greater than 1,000,000 parts per million (mg/kg); such cases are noted by the following indicator ">1,000,000" in Table 10. For those RBSLs that were based on inhalation, if a calculated RBSL is greater than both the saturation limit in soil and 1,000,000 mg/kg, ">1,000,000" is shown in Table 10 as it is more indicative of the level of health-protectiveness.

A comparison of the representative COPC concentrations to RBSLs for each of the exposure scenarios is presented in Table 10. This comparison provides a preliminary screening of potential risk to the specific receptor populations and exposure pathways identified for this SWMU. As presented in Table 10, the representative concentrations of benzene and naphthalene in subsurface SWMU material exceed the indoor vapor inhalation RBSLs for the future commercial/industrial worker scenario. The representative concentrations of benzo(a)pyrene, dibenz(a,h)anthracene and naphthalene in subsurface SWMU material exceed respective direct contact RBSLs for the future construction worker scenario, and the representative concentrations of benzo(a)pyrene in subsurface SWMU material exceeds the direct contact RBSLs for the future utility/maintenance worker scenario. For all other scenarios, chemicals and pathways, the representative concentrations are below the respective RBSLs, and therefore, are not evaluated further.

In accordance with Part IV, those COPCs that do not exceed the Tier 1 RBSLs are not evaluated further. For those COPCs that exceed Tier 1 RBSLs, the risk to human health is evaluated further in the Tier 1 Risk Characterization.

3.4 Risk Characterization

Risk characterization involves the estimating of the magnitude of potential adverse health effects of the COPCs, and summarizing the nature of the health impact to the defined receptor populations. Risk characterization combines the results of the toxicity and exposure assessments to provide numerical estimates of health risk.

In accordance with Part IV, those COPCs that exceeded an RBSL were further evaluated in the Tier 1 Risk Characterization, or HHRA. A Tier 1 HHRA provides an estimate of risk and hazard based on a comparison of the RBSL (*i.e.*, health-protective levels) to the COPC concentrations (*i.e.*, site-specific levels). Specifically, for those COPCs that exceeded an RBSL, a screening-level hazard index (SLHI) was calculated to evaluate noncarcinogenic health effects, and a total screening-level cancer risk ($SLCR_{total}$) was calculated to evaluate carcinogenic effects. The SLHI and $SLCR_{total}$ methodologies are presented in the Work Plan (BSC 1997). The Tier 1 HHRA results are presented in Table 11.

3.4.1 Noncarcinogenic Hazards

The noncancer hazards were assessed in this HHRA using a hazard quotient approach (USEPA 1989). For each COPC, the noncarcinogenic RBSL was compared to the COPC's representative concentration to determine the screening level hazard quotient (SLHQ) for that chemical. The equation is as follows:

$$SLHQ = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}}$$

The SLHQs for each chemical are summed to create a total Screening Level Hazard Index ($SLHI_{total}$) for each pathway. The smaller the SLHQ/SLHI, the greater the degree of protection for that pathway. Based on USEPA methodology (USEPA 1989) and as discussed in the Work Plan, if the SLHI is less than 1, the risks are considered to be negligible. The SLHI was further evaluated by developing target organ-specific SLHIs. This process is appropriate as only certain chemicals affect similar biological target endpoints; it is only relevant to quantify the additive effects of these chemicals. This process is illustrated in Table 11.

The SLHI totals are greater than 1 for two worker populations (commercial/industrial and construction). The $SLHI_{total}$ for the future commercial/industrial worker scenario is 14.8, as a result of inhalation of indoor benzene (SLHQ = 1.2) and naphthalene (SLHQ = 13.6) vapors from subsurface SWMU material. The $SLHI_{total}$ for the future construction worker scenario is 3.6; it is a result of direct contact (including vapor inhalation) with naphthalene in subsurface SWMU material.

In accordance with the work plan, as the $SLHI_{total}$s are greater than 1, each is subject to further evaluated by target organ. This step was only necessary for the future commercial/industrial worker scenario, as it was the only scenario with RBSL exceedances for more than one noncarcinogenic chemical (for the future construction worker scenario, the total upper respiratory system equals the $SLHI_{total}$ as naphthalene is the only chemical evaluated in the risk characterization). For the commercial/industrial scenario exposed to indoor vapors, the blood/immune system SLHI is 1.2 (benzene in subsurface SWMU material) and the upper respiratory system SLHI is 13.6 (naphthalene in subsurface SWMU material).

3.4.2 Carcinogenic Risk

In a human health risk assessment, carcinogenic health risks are defined in terms of the probability of an individual developing cancer over a lifetime as the result of exposure to a given chemical at a given concentration (USEPA 1989). The incremental probability of developing cancer over a lifetime (*i.e.*, the theoretical excess lifetime cancer risk) is the additional risk above and beyond the cancer risk an individual would face in the absence of the exposures characterized in this risk assessment. In this Tier 1 HHRA, cancer risk was evaluated according to the following equation:

$$SLCR = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}} \; x \; \text{Target Risk Level}$$

Cancer risks are summed regardless of the differences in target organ, weight-of-evidence for human carcinogenicity, or potential chemical interactions (*e.g.*, antagonistic or synergistic effects). This approach is consistent with USEPA's current approach to carcinogenic effects, which is to assume effects are additive unless adequate information to the contrary is available (USEPA 1989). Based on USEPA methodology (USEPA 1989) and as discussed in the Work Plan, if the total screening level cancer risk ($SLCR_{total}$) for each receptor/pathway is less than 1×10^{-4}, the risks are considered to be negligible.

All SLCRs are less than $1x10^{-4}$ for all receptor populations. For the future commercial/industrial worker scenario, the $SLCR_{total}$ for the indoor worker scenario is 5×10^{-6} from benzene in subsurface SWMU material. The $SLCR_{total}$ for the future construction worker scenario is 9×10^{-6}, attributable to direct contact with benzo(a)pyrene and dibenz(a,h)anthracene in subsurface SWMU material. The $SLCR_{total}$ for the utility/maintenance worker scenario is 2×10^{-6}, attributable to direct contact with benzo(a)pyrene in subsurface SWMU material.

3.5 Conclusion

The results of the Tier I HHRA indicate that benzene and naphthalene in subsurface SWMU material exceed noncarcinogenic RBSLs and result in calculated hazard indices greater than the Tier 1 benchmark of 1.0. Specifically, for the future commercial/industrial worker, the calculated hazard index for benzene and naphthalene in subsurface SWMU material is greater than the Tier 1 noncarcinogenic benchmark. Additionally, for the future construction worker scenario, the calculated hazard index for naphthalene in subsurface SWMU material is greater than the Tier 1 noncarcinogenic benchmark. It should also be noted that of the COPCs in subsurface SWMU material, as indicated in Table 7, anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene and naphthalene, exceed their saturation limits in soil.

Based on these results and in accordance with the work plan, further evaluation will be completed during the Corrective Measures Study (CMS) and may include a Tier 2 assessment or an evaluation of corrective measures. The uncertainties inherent in these conclusions are presented in the following Uncertainty Analysis.

3.6 Uncertainty Analysis

There are multiple sources of uncertainty associated with any risk assessment. These include, among others, uncertainty associated with the toxicity criteria used to derive dose-response factors, uncertainties associated with exposure parameters used in the exposure assessment, and uncertainties associated with combining exposure parameters and toxicity criteria to characterize risk.

In the development of any health assessment, some level of uncertainty is introduced each time an assumption is relied upon to describe a dynamic parameter. Some assumptions have a significant scientific basis while others do not, which may result in the selection and use of conservative, default exposure parameters in the exposure assessment. The selection of multiple conservative assumptions in the exposure assessment generally results in an overestimation of potential health risks associated with exposure to specific chemical constituents. The primary areas of uncertainty for this risk assessment are qualitatively discussed below.

3.6.1 Exposure Scenarios

The evaluation of exposure scenarios that are not necessarily representative of realistic exposures based on current and future land use creates uncertainty in the overall risk potential of the SWMU and the site. Many exposure scenarios evaluated in this risk assessment are not realistic in terms of planned redevelopment for the site. The placement of a building on SWMU S-14 site is not planned and not likely, given the location of this SWMU. A Tier 1 risk is generated for a scenario that does not currently exist, nor is likely to exist in the future.

3.6.2 Site Sampling and Representative Concentrations

SWMU samples were selected in an attempt to identify the highest concentrations of chemicals at the site. Sample biasing was accomplished based on visual observations and photoionization detector (PID) readings. Thus, the sampling activities are thought to have characterized the most highly impacted areas of the SWMU, and not an average. This is conservative, as a potential receptor is not expected to remain on, or inhale particulates from, one portion of the SWMU for his or her entire exposure duration. Therefore, it is believed that the maximum concentrations used in this HHRA are likely to represent the true maximum site concentrations.

It should also be noted that for all of the COPCs in SWMU material, the maximum concentrations were used as the representative concentrations in this HHRA. As less than ten samples were collected for surface and for subsurface SWMU material, a 95% UCL could not be calculated. The representative concentrations were used to compare to the RBSLs calculated for this HHRA, and ultimately determine the chemicals of interest in this HHRA. Use of the maximum concentrations of the biased sampling is a very conservative methodology utilized in this HHRA.

It should also be pointed out that some of the COPC's maximum concentrations were greater than the chemicals' saturation limits (see Table 7). Thus, as it is conservative to use the maximum concentration, it should still be noted that free product likely exists. Also, the maximum concentration of benzene in subsurface SWMU material is the average of two field duplicate samples, which are both estimated values. Thus, the confidence in risk calculations involving this concentration is somewhat less than for other calculations.

3.6.3 COPC Selection Process

The COPCs evaluated for SWMU S-14 were identified in the Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC 1998). These chemicals were selected in part because of their representative concentrations exceeded Region III RBCs (USEPA 2000) for residential scenarios. Since no residential exposures are realistic for any of the on-site scenarios, some chemicals have been retained as COPCs that are not likely to pose a potential threat to most of the human receptors evaluated here.

3.6.4 Exposure Parameters

Several conservative default exposure parameters (*e.g.*, inhalation rates, exposure frequency, exposure duration) were incorporated into the exposure assessment to define general population behavior. For example, for the industrial/commercial worker scenarios, default exposure parameters are intended to be conservative and representative of an individual who is consistently present at the site 24 hours a day, 250 days a year, in the area of highest concentration. It is more likely that the exposure of an industrial worker to a *particular SWMU* (i.e., SWMU material) on the Lackawanna site is limited to an average of only a few hours a day, 2 weeks year. Most parameters incorporated into the exposure assessment to define the receptor scenarios are conservative values and used to define a worst-case population behavior. The net effect of using multiple conservative exposure assumptions is the overestimation of potential health risks.

Additionally, for a receptor population such as an industrial worker or a resident (*i.e.* where exposure duration is greater than 250 days/year), exposure frequency typically is corrected in site-specific health risk assessments for the fraction of the year when outdoor exposure to soil will be limited due to severe weather conditions such as snow, ice, rain and freezing temperatures (USEPA 1989). This factor is called a meteorological factor. Because of the geographical location of the Lackawanna site, a correction factor for weather conditions would be reasonable. In this Tier 1 human health risk assessment, exposure did not exclude days when the temperature is less than 32°F and not when there is snow cover or the ground was wet from other forms of precipitation. For SWMU S-14, the Tier 1 RBSLs were exceeded for the future commercial/industrial worker scenarios. Thus, applying a more realistic exposure frequency and a meteorological factor would result in higher RBSLs.

3.6.5 Toxicity Assessment

Noncarcinogenic Criteria- Toxicity information for many of the COPCs is limited for humans. Consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty will be associated with the calculated toxicity values. The USEPA derives reference concentrations (RfC; inhalation exposures) and reference doses (oral exposures) for chemicals using an uncertainty factor (UF) approach. The uncertainty factor for naphthalene, for instance, is 3000. This was derived by applying a UF of 10 to account for extrapolation of the mouse study to humans, another UF of 10 to account for sensitive humans, another UF of 10 to account for extrapolation from a LOAEL to a NOAEL, and a final UF of 3 to account for lack of an appropriate reproductive study. In general, the procedures used to extrapolate from animals to humans in toxicity studies include a conservative use of uncertainty factors so that potential effects on humans are likely overestimated rather than underestimated. It is widely accepted in the scientific community that low doses of toxicants may be detoxified by any one of several processes present in human organ-systems (Ames *et. al.* 1987). As a result, humans may not react to the same degree as the population of genetically homogeneous laboratory animal populations used in standard bioassays.

Carcinogenic Criteria- USEPA cancer SFs are developed using variations of the Linear Multistage Model (LMS) for carcinogenicity. The LMS is highly conservative as it assumes linearity between dose and effect to zero dose assuming no threshold for carcinogenicity. However, the human body has mechanisms to detoxify most chemicals particularly at low doses, and therefore many scientists believe that most, if not all carcinogens only cause cancer above a "threshold dose."

The carcinogenic COPCs evaluated for SWMU S-14 include benzene. The inhalation slope factor for benzene is based on human data from occupational exposure studies, and thus an extrapolation from animal data is not necessary, thereby reducing the some uncertainty in the slope factors. However, there is significant uncertainty associated with the low dose extrapolation (environmental exposures are relevant in the low dose range) used to generate the slope factors. The EPA has used its default linear model to estimate risks in the low dose range citing lack of carcinogenic mode of action information. Thus, should this information become available, the low dose carcinogenic risks for benzene may be evaluated differently.

Absence of Inhalation Toxicity Criteria - Although toxicity information is generally available for the most significant chemicals and exposure routes in this HHRA, there were some volatile COPCs in this HHRA for which no inhalation toxicity criteria (RfDs or cancer slope factors) exist. In the absence of data, either the oral RfD or oral SF was used to evaluate inhalation exposures. The letter "R" on Table 9 notes these instances. It is more conservative to evaluate these chemicals for inhalation exposures than to not evaluate them at all. However, this methodology assumes that the chemical is equitoxic by both routes of exposure (oral and inhalation). Thus, this method potentially overestimates inhalation risks for COPCs evaluated as such. This uncertainty is not applicable to the inhalation RfCs or slope factors for the COPCs that showed exceedances of their Tier 1 RBSLs (benzene, naphthalene, and arsenic) at SWMU S-14.

3.6.6 Risk Characterization

Uncertainties in the risk characterization portion of the risk assessment for the site are a combination of the uncertainties associated with both the dose-response assessment and the exposure assessment. As discussed above, the assumptions and parameters used for both the dose response and exposure assessments are extremely conservative. In addition, since the toxicity criteria and exposure parameters are combined in the risk characterization, the conservatism is compounded.

3.6.7 Uncertainty Analysis Summary

This Tier 1 HHRA includes uncertainties and conservative assumptions that, in general, effectively combine to overestimate the potential current and future exposures. The major sources of uncertainty contributing to the conservatisms in this HHRA are summarized below:

- Evaluation future indoor industrial/commercial worker scenario
- Biased SWMU sample collection
- Use of maximum concentrations as representative concentrations
- Compounding effect of multiple conservative exposure parameters

- No meteorological factor adjustment
- Confidence in toxicity criteria

The net effect of the uncertainties of this HHRA is the generation of risk and hazard estimates that probably far exceed any true exposure conditions that currently exist or which could possibly exist in the future.

4.0 CONTAINMENT

SWMU S-14 was placed directly on slag fill and although there is no engineering containment structure, such as a liner or cover, in place, the majority of the pile is stabilized by vegetation. However, portions of the pile are exposed to wind and rain. A site inspection conducted in September 1996 by Dames & Moore revealed evidence of surface water runoff from the sides of the landfill. This runoff, however, will be confined to the area immediately surrounding the landfill (URS 2000 Inspection Report), where it will eventually infiltrate into the slag material because of the flat topography and porous nature of surrounding areas.

5.0 CONCLUSIONS

Based on review of the data, the following conclusion can be made:

- The 1995 TCLP extract concentration indicates that the material in SWMU S-14 does not meet TCLP criteria. While the total constituent analysis shows that the VOCs, SVOC, and metals are present, the SPLP data indicates the presence of SVOCs.

- Groundwater within Zone 4 contains concentrations of VOCs, SVOCs, and metals. The contribution of this particular SWMU to the groundwater within Zone 4 is not known.

- The results of the HHRA indicate that benzene and naphthalene in subsurface SWMU material exceed noncarcinogenic RBSLs and produce calculated hazard indices that are greater than the Tier 1 benchmark of 1.0. Specifically, for the future commercial/industrial worker, the calculated hazard index for benzene and naphthalene in subsurface SWMU material is greater than the Tier 1 noncarcinogenic benchmark. Additionally, for the future construction worker scenario, the calculated hazard index for naphthalene in subsurface SWMU material is greater than the Tier 1 noncarcinogenic benchmark.

- Additionally, COPCs anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene and naphthalene, in subsurface SWMU material exceed their saturation limits in soil.

- The presence of a restrictive covenant on the slag fill area, including S-14, restricts the current and future use of the property to commercial and industrial uses. In addition, the restriction also prevents the installation and operation of extraction or water wells for purposes other than environmental remediation use. This reduces the risk of exposure to the SWMU material.

Based on these results and in accordance with the Work Plan, further evaluation will be completed during the Corrective Measures Study (CMS) and may include a Tier II assessment or an evaluation of corrective measures.

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SWMU ASSESSMENT REPORT
GENERAL RUBBLE LANDFILL O
(SWMU S-15)

BETHLEHEM STEEL CORPORATION
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SEPTEMBER 2004

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Attachment A USEPA Comments

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1.0 INTRODUCTION

This report documents the results of an environmental assessment of the General Rubble Landfill O at Bethlehem Steel Corporation's (BSC), Lackawanna, New York facility. General Rubble Landfill O was identified by the United States Environmental Protection Agency (USEPA) as Solid Waste Management Unit (SWMU) S-15 in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA), (USEPA 1988). Process materials suspected by the USEPA to have been placed in SWMU S-15 might have included waste oils, solvents, and chemicals, which could have contained hazardous constituents and listed hazardous waste. No records exist within BSC to indicate this occurred. The USEPA required a RCRA Facility Investigation (RFI) of SWMU S-15 and other SWMUs at the BSC facility be completed in accordance with the Administrative Order of Consent (AOC) signed by BSC and the USEPA in 1990 (USEPA 1990). The RFI has been conducted in phases (Phase I, IIA, IIB, IIC, and III). The RFI included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property.

A preliminary SWMU Assessment report was completed for SWMU S-15 and submitted to the USEPA on January 5, 1993. Attachment A provides the USEPA comments regarding the preliminary SWMU assessment. This report evaluates SWMU data available to BSC as of November 2001.

1.1 Description

SWMU S-15 is located in Zone 4 of the Slag Fill Area, in the northwest portion of the BSC property, about 650 feet east of Lake Erie. The location of SWMU S-15 is presented in Figure 1. SWMU S-15 is roughly oval in plan view, approximately 150 feet long, 60 feet wide, and covers an area of approximately 9,000 square feet. The fill pile is 1.5 to 4 feet high. The estimated volume contained in SWMU S-15 is 1,000 cubic yards. The unit is sparsely vegetated and contains mostly slag and scrap material from steel production. Other debris including brick rubble, scrap billets, steel and iron buttons were also deposited in the SWMU. Slag underlies the site up to 50 feet below the base of the unit. Groundwater is approximately 25 feet below the surrounding slag surface.

1.2 History

According to the RFA, SWMU S-15 was first used as a disposal area for slag material, general debris and rubble from plant operations from approximately 1970 to 1983.

The SWMU contains mostly slag and scrap material resulting from steel production. The slag was placed in this unit for storage prior to the reclamation of metal. The principal source of the slag and some associated steel was from the pit areas of the open-hearth steel making shops. The slag and steel accumulated in the pits in a molten state. In addition, general debris consisting of brick rubble from the cleaning of the slag pockets of the open hearth furnaces, scrap billets from the bar mills, and steel and iron buttons from the bottoms of slag pots were normally mixed with other materials in the pits and were also deposited in the SWMU.

The material in the pits was periodically removed and transported to SWMU S-15 via rail cars or off-road trucks. Disposal of scrap and slag continued until steel-making operations ended in 1983. After the shutdown of operations, some scrap rubber tires were placed in SWMU S-15.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (USACE) show that dredge spoils from the Buffalo River and Outer Harbor were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the Slag Fill Area (SFA), including the area under SWMU S-15. The potential impact of these dredge spoils to groundwater beneath the site, especially in the sand unit in the SFA is further assessed in the RFI.

An initial inspection of SWMU S-15 was conducted in April 1992 by BSC. The unit appeared to contain general debris from steel-making operations. A September 1996 inspection by Dames & Moore personnel noted evidence of surface water runoff from the south side of the landfill. An April 11, 2001 site inspection by URS personnel also found similar conditions at the site. This runoff does not appear to reach Lake Erie through overland flow but remains confined to the area immediately surrounding the landfill where it eventually infiltrates the slag surface. Documentation of the 1996 and 2001 site visits are provided in Appendix A.

On February 20, 1996, BSC filed a declaration in the Erie County Clerk's Office limiting future use of the property in the area where the SWMU is situated. Under the declaration, the future use of the property is limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing and related railroad, port, and shipping activities. The deed restrictions also prevent the installation and operation of extraction or water wells for the purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants, and Restrictions is provided in Attachment B.

2.0 SAMPLING AND ANALYSIS

Samples of the fill material from SWMU S-15 were collected in February 1995, as part of the Phase IIC of the RFI. Sampling was conducted as outlined in the Phase IIC Work Plan (BSC 1994).

Groundwater was sampled from wells located directly upgradient and downgradient of SWMU S-15 during the Supplemental SWMU Investigation (2000). Groundwater sampling was conducted in accordance with work plans approved by USEPA (BSC 1989, revised 1990 and 2000). A complete list of site-specific compounds targeted for analysis in the site investigations is provided in Table 1, followed by a list of data qualifiers. Laboratory analytical reports are provided in Section II of the RFI.

2.1 Waste Samples

Two surface grab samples, S15-1 and S15-2, were collected from 0 to 6 inches below grade at the locations shown on Figure 1. The surface material was described as light to dark gray, medium- to coarse-grained sand and gravel-like material.

Laboratory analysis of the grab samples included solid phase analyses for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and cyanide. In addition, sample processing by the Toxicity Characteristic Leaching Procedure (TCLP) and the Synthetic Precipitation Leaching Procedure (SPLP) was conducted. Sampling field records are provided in Appendix B.

2.1.1 Total Constituent Results

Analytical results indicated the presence of thirteen SVOCs, seven metals, and cyanide. No VOCs were detected. The detected SVOCs ranged from 77 micrograms per kilogram (µg/kg) of naphthalene in S15-2 to 1700 µg/kg of fluoranthene. Detected concentrations of metals ranged from 0.12 milligrams per kilogram (mg/kg) of mercury to 138,000 mg/kg of calcium, both in S15-1. Analytical results from the soil sample are listed in Table 2.

2.1.2 SPLP Results

SPLP analyses were conducted to more closely mimic the effect of compounds leaching from soil due to rainwater infiltration. The SPLP results help evaluate what compounds can potentially leach from the soils and effect groundwater quality. The analyses were performed in accordance with the USEPA's SW 846 Method 1312 protocols.

Three metals were detected in the SPLP extracts. Detected metals results ranged from 0.008 milligrams per liter (mg/L) of selenium in S15-1 to 265 mg/L of calcium in S15-2. One VOC was detected, methylene chloride (0.003 mg/L); however, it was not detected in the total constituent analysis. It is probable that the detection is due to laboratory contamination. No SVOCs were detected. SPLP analytical results are summarized in Table 2.

2.1.3 TCLP Results

TCLP results were compared to regulatory concentration levels listed in 40 CFR Part 261. Only one metal, calcium, was detected in the TCLP analysis. The TCLP extraction concentrations indicate that the materials in SWMU S-15 do not meet the TCLP criteria. TCLP analytical results and regulatory levels are provided in Table 3.

2.2 Groundwater Sampling

Groundwater analytical data from monitoring wells MWN-35A and MWN-36A were used to evaluate groundwater quality upgradient and downgradient of SWMU S-15. Monitoring well MWN-35A is located downgradient of the SWMU and monitoring well MWN-36A is located upgradient of the SWMU. Both wells were installed in late 2000 as part of the Supplemental SWMU Investigation and are screened in the fill unit directly underlying the SWMU. Monitoring well locations and groundwater contour map of the fill unit is shown in Figure 2. The direction of groundwater flow in the fill unit is toward Lake Erie.

2.2.1 Groundwater Results

Groundwater wells MWN-35A and MWN-36A were sampled following their installation in 2000. Groundwater samples were submitted for VOC, SVOC, total and dissolved metals and general chemistry analysis. A summary of groundwater analytical data is provided in Table 4.

In the downgradient well MWN-35A, three VOCs, three SVOCs, nine total metals, and eight dissolved metals were detected. VOCs ranged from 4.8 micrograms per liter (ug/L) of toluene to 19 ug/L of total xylenes. SVOCs ranged from 3.8 ug/L of fluorene to 11 ug/L of naphthalene. Total metals ranged from 0.053 ug/L of mercury to 282,000 ug/L of calcium. Dissolved metals ranged from 3.3 ug/L of chromium to 275,000 ug/L of calcium. Cyanide was not detected.

In the upgradient well, MWN-36A, three VOCs, five SVOCs, twelve metals, and six dissolved metals were detected. VOCs ranged from 17 ug/L of total xylenes to 110 ug/L of benzene. SVOCs ranged from 3.4 ug/L of pyridine to 23 ug/L of naphthalene. Total metals ranged from 0.063 of mercury to 376,000 ug/L of calcium. Dissolved metals ranged from 0.09 ug/L of mercury to 215,000 ug/L of calcium. Cyanide was not detected.

In general, constituents of concern were found at higher concentrations in the upgradient well MWN-36A.

2.3 Summary of Analytical Results

TCLP analysis of the surface material indicates that the material in SWMU S-15 does not meet the TCLP criteria.

No VOCs were detected in the Total Constituent or TCLP analysis. One VOC detected in the SPLP analysis, methylene chloride, was not detected in the groundwater analysis.

Thirteen SVOCs detected in the Total Constituent analysis. No SVOCs were detected in the TCLP or SPLP analyses.

Of the nine metals detected in the total analyses only three were detected in the subsequent SPLP analyses.

Groundwater sampling data indicated that, in general, VOCs, SVOCs and metals, were detected at higher concentrations in the upgradient wells. The evaluation of the SPLP results with the upgradient and downgradient groundwater analytical results indicates that the SWMU material has not had an additive effect to the underlying groundwater quality.

Further evaluation of the compounds detected in the SWMU material will be presented in Section 3.0.

3.0 RISK ASSESSMENT

A human health risk assessment, as described in the *Human Health Risk Assessment* Work Plan (BSC 1997), was conducted for SWMU S-15, General Rubble Landfill O. The results of the Tier 1 Human Health Risk Assessment (HHRA) are presented here and are organized into the following sections: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization, and Uncertainty Analysis. The major components of this HHRA have previously been presented in Human Health Risk Assessment Report, Part IV of this RFI Report. Therefore, the following sections provide summary overviews of previously presented information. This section, therefore, serves as a summary report, bringing together all associated and related work from previous risk assessment deliverables, and providing the conclusions of the SWMU-specific risk assessment.

3.1 Data Evaluation

A list of 96 constituents of potential interest (COPIs) was developed for the BSC Lackawanna site based on USEPA and industry studies (BSC 1998). The list contains hazardous constituents that could be present in the waste streams as a result of integrated iron and steel plant operations, such as those historically conducted at the Lackawanna facility. The Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC 1998) established the chemicals of potential concern (COPCs) for each SWMU at the Lackawanna Facility. The COPCs were determined by sequentially applying the following criteria, as applicable, to each COPI on a medium by medium basis for each SWMU: 1) the chemical was detected in at least 5% of the samples, 2) the chemical was detected in at least one sample at levels above background (*i.e.*, the maximum concentration was above background; for chemicals in surficial SWMU material only) and 3) the chemical was positively detected in at least one sample at levels above applicable screening criteria [*i.e.*, the maximum concentration was greater than the screening criteria: USEPA Region III Risk Based Concentrations (RBCs), or NYSDEC Ambient Water Quality Standards and Guidance values].

The sampling data for SWMU S-15 (as presented in Section 2.0 of this report) were evaluated in order to identify the site-related COPCs for the SWMU. COPCs were originally determined in ID No. 1, however, as some screening criteria were revised since ID No. 1 was submitted, and because new groundwater samples within entire Zone 4 were collected, this screening process has been updated and is presented in Tables 5 and 6. Table 5 presents the screening of the surficial SWMU material and Table 6 presents the screening of groundwater. One inorganic COPC (antimony) was identified in surface SWMU material and fourteen volatile organic COPCs were identified in groundwater.

Representative concentrations were then determined for each COPC. If the sample size for a dataset was ten or greater, the 95% upper confidence limit (UCL) of the mean was used. For those datasets with sample sizes of less than ten, the maximum concentrations were used. Two samples were collected of the surficial SWMU material; therefore, the maximum concentration was used to represent all COPCs in SWMU material. SWMU S-15 is located in Groundwater Zone 4 (BSC 1998), for which more than ten samples have been collected; therefore, the 95% UCL was used for each of the COPC. The COPCs and their representative concentrations are presented in Table 6. These representative concentrations are used in the SWMU S-15 risk characterization.

3.2 Exposure Assessment

The exposure assessment conducted for SWMU S-15 included a review of current and future human receptor scenarios and potential exposure pathways, as related to COPCs. In general, exposure pathways by which a human receptor could come into contact with SWMU material are defined by four components (USEPA 1989):

- A source and mechanism of constituent release to the environment;
- An environmental transport mechanism;
- A point of potential human contact with the affected medium, and
- A route of entry into humans.

If any one of these components is missing, the pathway is considered incomplete and does not contribute to receptor exposure.

Human Health Risk Assessment ID No. 2 (BSC 1999) presented the current and future human receptor scenarios and potentially complete exposure pathways for each of the SWMUs identified at the Lackawanna Facility. Human Health Risk Assessment ID No. 1 (BSC 1998) identifies the COPCs; these COPCs were also integral in determining complete exposure pathways, based on their presence in each media (i.e., surface SWMU material or groundwater) and their volatility (e.g., inorganics in groundwater do not present a complete exposure pathway as they are not volatile and groundwater is not used as a drinking water source). Potential exposure pathways for S-15 are presented in Table 8 and below.

For SWMU S-15, the potential receptor scenarios include a current non-BSC commercial/industrial worker scenario, a future commercial/industrial worker scenario, a future construction worker scenario, a future utility/maintenance worker scenario, a present/future trespasser, a future marina worker scenario, a future greenway user, and a present/future fenceline resident. Potentially complete exposure pathways were established for each receptor. For the future commercial/industrial worker, construction worker, utility/maintenance worker and trespasser scenarios, the following pathways were determined to be complete: direct contact (i.e., ingestion or dermal contact) with surface SWMU material, inhalation of airborne particulates from uncovered surface SWMU material, or inhalation of ambient vapors from Zone 4 groundwater. For the future commercial/industrial worker scenario, a potential future indoor worker scenario is considered in addition to an ambient scenario. This worker may potentially inhale indoor vapors from groundwater and SWMU material. For the current non-BSC commercial/industrial worker, marina worker, greenway user, and residential scenarios, inhalation of particulates in surficial SWMU material is the only complete exposure pathway evaluated in this SWMU-specific risk assessment. A detailed description of the potentially exposed receptor scenarios and pathways for SWMU S-15 can be found in ID No. 2 (BSC 1999), and a summary is provided in Table 8.

3.3 Toxicity Assessment

A toxicity assessment characterizes the relationship between the exposure to a COPC and the frequency of adverse health effects that may result from such an exposure (dose-response). The end result of the dose-response assessment is the determination of human uptake levels that provide an adequate measure of protection to exposed persons for carcinogenic and noncarcinogenic endpoints. The derivation of acceptable levels of exposure (e.g., risk-based screening levels; RBSLs) and the manner in which these levels are used in this HHRA are discussed below.

Tier 1 RBSLs were calculated and compared to the representative SWMU S-15 COPC concentrations. RBSLs are defined as concentrations of COPCs in media that are not expected to produce any adverse health effects under assumed exposure conditions. Tier 1 RBSLs were developed using information previously defined and described in detail in the Work Plan and ID No. 2; this information is summarized here. The equations used to calculate the RBSLs follow basic USEPA risk assessment principles (USEPA 1989; 1996). Conservative exposure parameters, as defined by the ASTM Standard (ASTM 1995) and USEPA guidance (USEPA 1989, 1991a, and 1991b), and USEPA toxicity criteria (USEPA 2000a) were inputs into these equations to develop the RBSLs. As some of the toxicity criteria have been revised by the USEPA since originally presented in ID No. 1, the criteria for all chemicals have been re-presented in Table 9 of this HHRA. The above information was used to calculate Tier 1 RBSLs for COPCs in SWMU material and groundwater, for each of the nine exposure scenarios.

It should be noted that many of the groundwater RBSLs calculated are greater than the chemicals' solubility in water. This indicates that, based on the predicted amount of chemical volatilization, pure product in the groundwater would not pose a health threat from these chemicals. In such cases, the solubility limits of these chemicals are indicated in Table 10. Also, some of the RBSLs for COPCs in SWMU material were determined to be health protective at levels that are greater than 1,000,000 parts per million (mg/kg); such cases are noted by the following indicator ">1,000,000" in Table 10.

A comparison of the representative COPC concentrations to RBSLs for each of the exposure scenarios is presented in Table 10. This comparison provides a preliminary screening of potential risk to the specific receptor populations and exposure pathways identified for this SWMU.

For all scenarios, chemicals and pathways, the representative SWMU and groundwater concentrations are below their respective RBSLs. In accordance with Part IV RFI, those COPCs that do not exceed the Tier 1RBSLs are not evaluated further.

3.4 Conclusions

The results of the HHRA are that none of the chemicals in surface SWMU material or Zone 4 groundwater exceed Tier 1 noncarcinogenic or carcinogenic RBSLs for any of the scenarios.

Based on these results and in accordance with the work plan, further evaluation is not warranted during the Corrective Measures Study (CMS). The uncertainties inherent in these conclusions are presented in the following Uncertainty Analysis.

3.5 Uncertainty Analysis

There are multiple sources of uncertainty that may be identified for any risk assessment. These include, among others, uncertainty associated with the toxicity criteria used to derive dose-response factors, uncertainties associated with exposure parameters used in the exposure assessment, and uncertainties associated with combining exposure parameters and toxicity criteria to characterize risk.

In the development of any health assessment, some level of uncertainty is introduced each time an assumption is relied upon to describe a dynamic parameter. Some assumptions have a significant scientific basis while others do not, which may result in the selection and use of conservative, default exposure parameters in the exposure assessment. The selection of multiple conservative assumptions in the exposure assessment generally results in an overestimation of potential health risks associated with exposure to specific chemical constituents. As none of the COPCs exceeded their respective RBSLs, much of the information presented in this uncertainty analysis serves to strengthen the position that there are no chemicals that warrant further evaluation. The primary areas of uncertainty for this risk assessment are qualitatively discussed below.

3.5.1 Site Sampling and Representative Concentrations

For all COPCs in SWMU material, the maximum concentration was used as the representative concentration in this HHRA. This was because an insufficient number of samples were collected to calculate a 95% UCL. The representative concentrations were used to compare to the RBSLs calculated for this HHRA, and ultimately determine the chemicals of interest in this HHRA. Use of the maximum concentrations of the biased sampling is a very conservative methodology utilized in this HHRA.

3.5.2 COPC Selection Process

The COPCs evaluated for this SWMU were identified in the Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC 1998). These chemicals were selected in part because of their representative concentrations exceed USEPA Region III RBCs for residential scenarios. Since no residential exposures are realistic for any of the on-site scenarios, some chemicals have been retained as COPCs that are not likely to pose a potential threat to most of the human receptors evaluated here.

3.5.3 Evaluating Subsurface Data

As no data was collected in subsurface SWMU material, this medium was not evaluated in this HHRA. Not evaluating the subsurface SWMU material may result in the potential underestimation of risk for this SWMU.

3.5.4 Exposure Parameters

Several conservative default exposure parameters (*e.g.*, inhalation rates, exposure frequency, exposure duration) were incorporated into the exposure assessment to define general population behavior. Most parameters incorporated into the exposure assessment to define the receptor scenarios are conservative values and used to define a worst-case population behavior. For example, for the industrial/commercial worker scenarios, default exposure parameters are intended to be conservative and representative of an individual who is consistently present at the site 24 hours a day, 250 days a year, in the area of highest concentration. It is more likely that the exposure of an industrial worker to a *particular SWMU* (i.e., SWMU material) on the Lackawanna site is limited to an average of only a few hours a day, 2 weeks year. The net effect of using multiple conservative exposure assumptions is the overestimation of potential health risks.

Additionally, for a receptor population such as an industrial worker or a resident (*i.e.* where exposure duration is greater than 250 days/year), exposure frequency typically is corrected in site-specific health risk assessments for the fraction of the year when outdoor exposure to soil will be limited due to severe weather conditions such as snow, ice, rain and freezing temperatures (USEPA 1989). This factor is called a meteorological factor. Because of the geographical location of the Lackawanna site, a correction factor for weather conditions would be reasonable. In this Tier 1 human health risk assessment, exposure did not exclude days when the temperature is less than 32°F and not when there is snow cover or the ground was wet from other forms of precipitation applying a more realistic exposure frequency and a MET factor would result in higher RBSLs. For this SWMU, however, no Tier 1 RBSLs were exceeded for the future commercial/industrial worker scenarios.

3.5.5 Toxicity Assessment

Noncarcinogenic Criteria- Toxicity information for many of the COPCs is limited for humans. Consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty are associated with the calculated toxicity values. The USEPA derives reference concentrations (RfC;) for inhalation exposures and reference doses (for oral exposures) using an uncertainty factor (UF) approach. The uncertainty factor for antimony, for instance, is 1000. This was determined by multiplying 10 to account for interspecies conversion, 10 to protect sensitive individuals, and 10 because the effect level was a LOAEL and no NOEL was established. In general, the procedures used to extrapolate from animals to humans in toxicity studies include a conservative use of uncertainty factors so that potential effects on humans are likely overestimated rather than underestimated. It is widely accepted in the scientific community that low doses of toxicants can be detoxified by any one of several processes present in human organ-systems (Ames *et. al.* 1987). As a result, humans may not react to the same degree as the population of genetically homogeneous laboratory animal populations used in standard bioassays.

Carcinogenic Criteria- USEPA cancer SFs are developed using variations of the Linear Multistage Model (LMS). The LMS is highly conservative as it assumes linearity between dose and effect to zero dose, assuming no threshold for carcinogenicity. However, the human body has mechanisms to detoxify most chemicals particularly at low doses, and therefore many scientists believe that most, if not all carcinogens only cause cancer above some "threshold dose."

The carcinogenic COPCs evaluated for this SWMU include benzene. The inhalation slope factors for benzene are based on human data from occupational exposure studies, and thus an extrapolation from animal data is not necessary, thereby reducing some uncertainty in the slope factors. However, there is significant uncertainty associated with the low dose extrapolation (environmental exposures are relevant in the low dose range) used to generate the slope factors. The USEPA has used its default linear model to estimate risks in the low dose range citing lack of carcinogenic mode of action information. Thus, should this information become available, the low dose carcinogenic risks for benzene may be evaluated differently.

Absence of Inhalation Toxicity Criteria - Although toxicity information is generally available for the most chemicals and exposure routes in this HHRA, there are some volatile COPCs in this HHRA for which no inhalation toxicity criteria (RfDs or cancer slope factors) exist. In the absence of data, either the oral RfD or oral SF was used to evaluate inhalation exposures. The letter "R" on Table 5 notes these instances. It is more conservative to evaluate these chemicals for inhalation exposures than to not evaluate them at all. Thus, this method potentially overestimates inhalation risks for COPCs evaluated as such.

3.5.6 Uncertainty Analysis Summary

This Tier 1 HHRA includes uncertainties and conservative assumptions that, in general, effectively combine to overestimate the potential current and future exposures. The major sources of uncertainty contributing to the conservatism in this HHRA are summarized below:

- Use of maximum concentrations as representative concentrations
- Not evaluating subsurface SWMU material
- Compounding effect of multiple conservative exposure parameters
- Confidence in toxicity criteria

The net effect of the uncertainties of this HHRA is the generation of risk and hazard estimates that likely exceed any actual, reasonable exposure conditions that currently exist or that could possibly exist in the future.

4.0 CONTAINMENT

The waste stored at SWMU S-15 is uncovered and based on information obtained from BSC Lackawanna facility personnel, was piled directly on the ground surface. There are no engineered landfill structures such as covers or liners present.

Precipitation runoff from SWMU S-15 remains confined to the area immediately surrounding the landfill because of the flat topography of the area. The runoff infiltrates into the surface, or evaporates.

5.0 CONCLUSIONS

Based on review of the data, the following conclusion can be made.

- Total constituent analysis shows that SVOCs and metals are present within the SWMU material. SPLP analysis shows only a few metals were detected.

- TCLP extract concentrations indicate that the materials in SWMU S-15 do not meet the TCLP criteria.

- Groundwater results indicated that, in general, constituents of concern were detected at higher concentrations in the upgradient well than in the downgradient well.

- Evaluation of the SPLP results with the upgradient and downgradient groundwater analytical results indicates that the SWMU material has not had an additive on the underlying groundwater quality.

- The HHRA shows that there are no COPCs in the SWMU material or Zone 4 groundwater that generate noncarcinogenic hazards or cancer risk.

- The results of the HHRA indicate that none of the chemicals in surface SWMU material or Zone 4 groundwater exceeds noncarcinogenic Tier 1 or carcinogenic RBSLs for any of the scenarios.

Based on these results and in accordance with the work plan, further evaluation is not warranted during the CMS.

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SWMU ASSESSMENT REPORT
LIME STABILIZATION PICKLE LIQUOR SLUDGE LANDFILL (SWMU S-16)

BETHLEHEM STEEL CORPORATION
LACKAWANNA, NEW YORK

SEPTEMBER 2004

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1.0 INTRODUCTION

This report documents the results of an environmental assessment of Lime Stabilized Pickle Liquor Sludge Landfill at Bethlehem Steel Corporation's (BSC's) Lackawanna, New York facility. The Lime Stabilized Pickle Liquor Sludge Landfill, designated by the United States Environmental Protection Agency (USEPA) as Solid Waste Management Unit (SWMU) S-16 in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (USEPA 1988) because it received spent pickle liquor (SPL) sludge. SWMU S-16 is one of three SWMUs that are part of the Hazardous Waste Management (HWM) Units located at BSC's Lackawanna facility. The USEPA has required that a RCRA Facility Investigation (RFI) of this and other SWMUs at the BSC facility be completed in accordance with the Administrative Order on Consent (AOC) signed by BSC and USEPA in 1990 (USEPA 1990). The RFI has been conducted in several phases and included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. This report evaluates SWMU data available to BSC as of April 2002.

1.1 Description

SWMU S-16 is located north of Smokes Creek, along the northwest edge of Zone 4 of the Lackawanna facility's Slag Fill Area (SFA) (Figure 1). SWMU S-16 is one of two SWMUs that make up HWM-1. SWMU S-16 is known as HWM-1A and SWMU S-13 is known as HWM-1B (SWMU S-13 is discussed in another report). SWMU-16 covers an area of approximately 0.25 acres and is immediately adjacent to, and surrounded on three sides by SWMU S-23. The unit's base is estimated at 28 feet [582 feet above mean sea level (amsl)] below surrounding grade and filled to a depth of approximately 1 foot below grade.

An estimated 5,900 cubic yards of stabilized SPL sludge, steel-making slag, and blast furnace slag is contained in SWMU S-16. The landfilled material is covered with a geomembrane cover and is surrounded on the north, east, and south by SWMU S-23, which is known to contain volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). The geomembrane cover is constructed of 30 MIL thick polyvinyl chloride (PVC) material. An access road is present along the west side of the landfill. The access road was used to transport SPL to SWMU S-16.

The local groundwater table lies at an elevation of approximately 576 feet amsl. The bottom of the landfill is estimated to lie at an elevation of 582 feet amsl, providing a 6-foot separation between the stored materials and the local groundwater table.

1.2 History

On June 13, 1978, the New York State Department of Environmental Conservation (NYSDEC) issued Permit 2206 to BSC Lackawanna facility to operate an industrial solid waste disposal facility at SWMU S-16 under 6 NYCRR Part 360 (Appendix A). Records from 1981 and 1982, during the four years that SWMU S-16 operated under Interim Status (1981 through 1984) indicate that 761,000 gallons of SPL was disposed of in the landfill in 1981 and 128,000 gallons of SPL was disposed of in the landfill in 1982.

The SPL generated at the BSC Lackawanna facility was treated in this unit by pouring the SPL over the lime rich slag at SWMU S-16. Beginning in November 1980, a portion of SPL generated at the BSC Lackawanna facility was disposed of through CECOS International.

In the fall of 1981, SPL was shipped to a local publicly owned treatment works (POTW) as a treatment chemical. Records indicate that all SPL generated in November and December 1981, more than 98 percent of the SPL generated in 1982, and all of the SPL generated in 1983 was shipped to a local POTW as a treatment chemical.

The SPL placed in the landfill was generated at two BSC Lackawanna facilities: the Cold Strip Mill Continuous Pickling Facility; and the Bar Mill Batch Pickling Facility. Pickling consists of immersing steel in a hot acid solution to remove oxide scale and other surface impurities prior to further mechanical processing. During the pickling process, the acid solution chemically removes iron oxide from the surface of the steel and thus becomes higher in iron content and lower in free acid content. When the pickling solution reaches pre-determined levels of iron content and free acidity, it is considered spent pickle liquor. In the pickling processes, the feed/raw materials were virgin acids (sulfuric acid and hydrochloric acid), carbon steel, water and steam. The carbon steel feedstock consisted of hot-rolled strip steel and hot-rolled bar steel. The pickling solution at the Cold Strip Mill Continuous Pickling Facility consisted of hydrochloric acid, water, and an inhibitor. The pickling solution at the Bar Mill Batch Pickling Facility consisted of sulfuric acid, water, and an inhibitor.

(Schematic diagrams of the Bar Mill Batch Pickling Facility and the Cold Strip Mill Continuous Pickling Facility are shown in Figures 1 and 2 of Appendix E, respectively). The SPL was trucked to SWMU S-16 where it was poured over a 40-foot deep bed of steel-making and blast furnace slag. The iron and other heavy metals in the SPL precipitated as hydrous oxides and the precipitate attenuated with the slag.

SWMU S-16 is considered a HWM unit since the SPL, which meets according to USEPA and NYSDEC the definition of a RCRA hazardous waste from a specific source was disposed of in the SWMU. SPL is considered a RCRA hazardous waste since it normally contains chromium and lead. Pursuant to a Consent Agreement entered into between BSC and the USEPA in August 1985, BSC agreed to develop and implement a groundwater monitoring program for the HWM units and to submit closure and post-closure plans for the HWM units. A copy the Consent Agreement is provided in Appendix B. The RCRA closure and post-closure plans can be found in Appendix C. The closure plans included the installation of an impermeable rubber cap on top of the landfill to prevent run-off from infiltrating the ground surface. The Groundwater Monitoring Sampling and Analysis Plan, HWM-1 and HWM-2 can be found in Appendix D.

In 1985, BSC submitted a petition to the USEPA to de-list the wastes contained in SWMU S-16. The material in SWMU S-16 was found not to exceed toxicity criteria and was mixed with ash and slag. As stated in 40 CFR 261.3(a)(iii), a mixture of a solid waste and a characteristic hazardous waste is not considered a RCRA hazardous waste "if the resultant mixture no longer exhibits any characteristic of hazardous waste identified in subpart C of this part for which the hazardous waste listed in subpart D of this part was listed." A copy of the de-listing petition can be found in Appendix E. BSC is awaiting a final determination from the USEPA on the de-listing petition for SWMU S-16.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (USACE) show that dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-16. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI. Because of the USACE dredge spoils, the contribution of this particular SWMU to groundwater contamination within the sand unit is not known.

During the 1990s, the SWMU was inspected several times. A June 1992 visual inspection conducted by BSC revealed that the site was in good condition and that the cover was in good condition. A May 1996 inspection conducted by Dames & Moore again showed that the landfill was in good condition and that the cover was intact. A September 1996 inspection conducted by Dames & Moore confirmed that the landfill was in good condition and there was no evidence of surface water runoff from the SWMU. In July 2000, an inspection conducted by URS Corporation (URS) verified that no changes had occurred in the landfill in the four years prior the last inspection. A copy of the September 1996 and July 2000 inspection reports are provided in Appendix F.

On February 20, 1996, BSC filed a declaration in the Erie County Clerk's Office limiting future use of the property around and including SWMU S-16. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevented the installation and operation of extraction or water wells for purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants, and Restrictions is attached as Attachment A.

2.0 SAMPLING AND ANALYSIS

Samples of the SPL sludge were collected in 1979 and 1984. Analytical data for the 1979 sampling event were not available for review. Waste samples were collected from the material contained in SWMU S-16 in 1984. The 1984 samples were initially analyzed for toxicity Characteristic Leaching Procedure (TCLP) and total chromium, hexavalent chromium, and lead. The same samples were subsequently reanalyzed in 1985 for a larger list of total metals. The analytical results are discussed in detail in Section 2.1. The sampling was performed in conjunction with BSC's Delisting Petition. Analytical results, sample records and boring logs are included in the Delisting Petition (Appendix E). Pages 10 and 11 of the Petition also provide a summary of the average analytical results of the 1979, 1984 and 1985 sampling events.

Groundwater has been collected since 1986. Groundwater monitoring wells MW-1D1, MW-1D6, MW-1D7, and MWN-12 were used to evaluate groundwater beneath SWMU S-16. A groundwater mound within the fill unit exists beneath the SWMU as shown in Figure 2. Because of this mound, all four wells are located downgradient of the SWMU. Although the cause of the mound has not been fully determined, it is likely to be related to a lower permeability of the slag in this area. Slag within the area of SWMU S-16 is likely to have precipitated within the annular spaces, resulting from the placement of the SPL into this area. Additionally, the presence of an impermeable SWMU cover and the adjacent SWMU S-23, which is known to contain low permeability tar material, is likely to cause the mound to shift to the western edge of SWMU S-16.

Although MW-1D1, MW-1D6, MW-1D7, and MWN-12 have been sampled regularly as part of the HWMU monitoring program, all four wells were sampled simultaneously in 1999 as part of the RFI program. All groundwater sampling was conducted in accordance with the Groundwater Quality Assessment Plan (BSC 1987), the Data Collection Quality Assurance Plan (BSC 1989), Phase I Work Plan (BSC 1990), the Phase IIB Work Plan (BSC 1993), the Groundwater Monitoring Sampling and Analysis Plan (HWM-1 and HWM-2) (BSC 1994a), the Phase IIC Work Plan (BSC 1994b), the Natural Attenuation Phased Study Work Plan (BSC 1997) and the Comprehensive Well Sampling Plan (BSC 1999a). A complete list of the site-specific compounds targeted for analysis in the RFI site investigations is provided in Table 1. USEPA data qualifiers are presented following Table 1. Laboratory analytical reports are provided in Section II of the RFI.

2.1 Delisting Waste Sampling

In April 1984, a surface waste sample, D1, was collected from SWMU S-16. The sample was analyzed for EP Toxicity for total chromium and lead. Table 1 and Figure 4 in Appendix E indicates the sample is a grab sample; however, the sample records are not available.

In September 1984, five borings, (B-1 through B-5) were advanced in SWMU S-16. Seven composite subsurface waste samples were collected from three of the five boreholes. The table below shows the boring number and sample ID. Samples were not collected from borings B-1 or B-5 because there was no visual evidence of SPL impacted soil. The depths are estimated from boring logs and diagrams provided in Appendix E. A summary diagram of the sampling intervals is provided in Figure 4 of the Delisting Petition (Appendix E).

Boring No.	Sample ID	Feet below ground surface
B-1	--	---
B-2	2	(17 to 17.8 feet)
	3	(20 to 22 feet and 25 to 27 feet)
	4	(30 to 36 feet)
B-3	5	(4 to 8 feet)
	6	(8 to 12 feet)
	7	(15 to 17 feet)
B-4	1	(13 to 16.5 feet and 26 to 28 feet)
B-5		---

The samples were initially submitted to ARO Corporation in 1984 and were analyzed for Total Constituent analysis of chromium, hexavalent chromium, and lead and EP Toxicity for arsenic, barium, cadmium, total chromium, hexavalent chromium, lead, mercury, selenium, silver and nickel.

Based on visual observations, the highest concentration of SPL sludge was encountered at borehole B-3, which is located closest to where the SPL was placed into SWMU S-16. At borehole B-2 only one concentrated zone of SPL sludge was encountered at the 17.0- to 17.8-foot interval, and, in general, only small amounts of SPL sludge mixed with very dense slag was observed in the 17.7- to 29.0-foot interval. At borehole B-4 slag with considerable amounts of SPL sludge was observed in the 13.0- to 16.5-foot interval with a secondary, less concentrated zone observed in the 26.0- to 28.0-foot interval.

In April 1985, samples "2, 5, 6, 7" were reanalyzed by ARO Corporation. The samples were analyzed for metals using EP Toxicity and total cyanide using EP Toxicity method with distilled water. In addition, total constituent analysis was performed on the samples for metals, free and total cyanide, photodegradable cyanide, sulfide, percent solids, total organic carbon (TOC), oil and grease. The oil and grease were part of the analysis because small quantities of (primarily) lubricating oils were used at the pickling facility and minor leaks and spills may have occurred.

2.1.1 1984 Waste Sampling Results – EP Toxicity

For sample D1, total chromium was not detected. Lead was detected at 0.014 milligrams per liter (mg/L), which is below the criteria for lead.

For the seven composite samples ("1, 2, 3, 4, 5, 6, and 7"), nine of the ten metals analyzed for were detected. Hexavalent chromium was not detected in any of the samples. Metals ranged from 0.001 mg/L of arsenic in sample "1" to 0.58 mg/L of nickel in sample "5". Metals concentrations did not meet TCLP criteria.

A summary of the analytical results is provided in Table 1 of Appendix E.

2.1.2 1985 Waste Samples - EP Toxicity

The April 1985 leachability analysis disclosed that two metals (barium and nickel) were present above method detection limits in the extracts of composite samples "2, 5, 6, and 7". Barium ranged from 0.19 mg/L in sample "7" to 0.25 mg/L in sample "6". Nickel ranged from 0.05 mg/L in sample "6" to 0.47 mg/L of nickel in sample "5". The concentrations of these metals did not meet TCLP criteria.

These samples were also processed for total cyanide using distilled water to extract the samples. No total cyanide was detected in any of the four samples.

A summary of the analytical results is provided in Table 2 of Appendix E.

2.1.3 1984 Waste Sampling Results – Total Constituent Analysis

Samples "1, 2, 3, 4, 5, 6, and 7" were also analyzed for Total Constituents of chromium, hexavalent chromium, and lead. Chromium ranged from 0.75 milligrams per kilogram (mg/kg) in sample "3" to 115 mg/kg in sample "2". Lead ranged from 0.84 mg/kg in sample "3" to 170 mg/kg in sample "5". Hexavalent chromium was not detected in any of the samples.

A summary of the analytical results is provided in Table 3 of Appendix E.

2.1.4 1985 Waste Samples – Total Constituent Analysis

The four composite samples "2, 5, 6, and 7" were also analyzed for Total Constituents for metals, total cyanide, free cyanide, photodegradable cyanide, sulfides, solids, TOC, and oil and grease.

Eight metals were detected ranging from 0.006 mg/kg of mercury in sample "5" to 415 mg/kg of barium in sample "6". Total cyanide ranged from 2.86 mg/kg in sample "2" to 72.6 mg/kg in sample "7". Free cyanide ranged from 0.41 mg/kg in sample "2" to 1.14 mg/kg in sample "7". Photodegradable cyanide ranged from 0.02 mg/kg in samples "5" and "6" to 0.04 mg/kg in sample "7". Sulfide ranged from 2.9 mg/kg in sample "6" to 4.7 mg/kg in sample "5". Oil and grease ranged from 0.24% in sample "5" to 2.68% in sample "2".

A summary of the analytical results is provided in Table 4 of Appendix E.

2.2 Groundwater Sampling

Data from four monitoring wells (MW-1D1, MW-1D6, MW-1D7, and MWN-12) were used to evaluate groundwater quality near SWMU S-16. All four wells are considered downgradient of SWMU S-16. There are no upgradient wells to use as comparison for SWMU S-16. The location of the monitoring wells and groundwater elevation contours are shown in Figure 2 and Figure 3. The materials within the SWMU cause the groundwater in the fill unit to mound and flow radially away from the SWMU S-16/S-23 area.

A Mann-Kendall trend analysis has been used to discuss groundwater for the years 1986 through 2001. This analysis shows the trend of analytes within the groundwater and is presented in Section 2.2.1. Only the analytes that show a trend (upward or downward) are discussed. Although a site wide sampling program was performed as part of the RFI in 1999, the most current sampling data is from the October 2001 HWM semi-annual sampling event and is used to discuss the current conditions of the groundwater beneath SWMU S-16 (Section 2.2.1.).

2.2.1 Groundwater Trends

The following table presents the detected analytes and their trend toward an increase or decrease in concentration throughout the period from 1986 through 2001. In some cases, "no trend" was determined due to insufficient data or no dramatic change in analyte concentrations. These "no trends" are designated as "NT" on the table below.

Parameter	Analyte	MW-1D1	MW-1D6	MW-1D7	MWN-12
VOCs	Benzene	Downward	NT	Downward	Downward
	1,1-Dichloroethane	Downward	NT	NT	NT
	Methylene chloride	NT	Downward	NT	NT
	Trichloroethene	Downward	NT	Upward	NT
	Xylenes, Total	Downward	NT	NT	Downward
SVOCs	2,4-Dimethylphenol	NT	NT	Downward	Downward
	bis(2-Ethylhexyl)Phthalate	NT	NT	Downward	NT
	Fluoranthene	NT	Downward	Downward	Downward
	Fluorene	NT	Downward	NT	Downward
	3-Methylphenol & 4-Methylphenol	NT	Downward	NT	Downward
	Naphthalene	Upward	Downward	Downward	Downward
	Phenanthrene	NT	NT	Downward	Downward
	Phenol	Upward	NT	NT	NT
	Pyrene	NT	NT	NT	Downward
Metals	Arsenic	NT	Upward	NT	NT
	Barium	NT	Upward	Upward	Upward
	Calcium	Downward	NT	Downward	NT
	Chromium	Upward	NT	NT	Upward
	Magnesium	Downward	NT	Downward	NT
	Potassium	Downward	Downward	NT	NT
	Selenium	Upward	Upward	NT	NT
	Sodium	Downward	Downward	Downward	NT
Dissolved Metals	Arsenic	Upward	Upward	NT	NT
	Barium	Upward	Upward	Upward	Upward
	Calcium	Downward	NT	NT	NT
	Chromium	Upward	NT	Upward	NT
	Magnesium	NT	Upward	Downward	NT
	Potassium	Downward	Downward	Downward	Downward
	Selenium	Upward	Upward	NT	NT
	Sodium	Downward	Downward	Downward	Downward

As the table shows, eighteen (18) parameters exhibited a downward trend over time. In general the majority of the VOCs and SVOCs concentrations decreased over time. Conversely, nine (9) parameters exhibited an upward trend in concentration over time. The majority of the nine parameters was metals or dissolved metals. Most of the parameters showing upward trends in concentrations were detected in wells MW-1D1 and MW-1D6.

Three compounds (dissolved sodium, dissolved potassium, and dissolved barium) exhibited a common trend in all four wells. Dissolved sodium and dissolved potassium exhibited a downward trend. Dissolved barium exhibited an upward trend.

Of the compounds that would most directly be associated with the spent pickle liquor stored within the SWMU; chromium and lead, only chromium has been detected and showed an upward trend in concentration in two wells. The trend analysis report is provided in Appendix G.

2.2.2 2001 Sampling Event

Groundwater monitoring wells, MW-1D1, MW-1D6, MW-1D7 and MWN-12 were sampled in April and October of 2001 as part of the RFI Semiannual Groundwater monitoring program for the HWM units. For wells MW-1D1, MW-1D7, and MWN-12, the October 2001 event was used to discuss groundwater conditions beneath SWMU S-16. According to field records, well MW-1D6 did not produce enough groundwater for a complete analysis and, therefore, the April 2001 sampling event has been used for discussion.

Eight VOCs, eleven SVOCs, ten metals, ten dissolved metals, and cyanide were detected in the wells. SVOCs were not detected in MW-1D6. VOCs ranged from 1.3 micrograms per liter (ug/L) of toluene in MW-1D1 to 50 ug/L of 1,1-dichloroethane in MW-1D6. SVOCs ranged from 0.95 ug/L of phenol to 58 ug/L of naphthalene, both detected in MWN-12. Metals ranged from 0.088 ug/L of mercury in MWN-12 to 769,000 ug/L of calcium in MW-1D6. Dissolved metals ranged from 0.13 ug/L of mercury in MWN-12 to 850,000 ug/L of calcium in MW-1D7. Cyanide was detected in MW-1D1 and MW-1D7 at 55 milligrams per liter (mg/L) and 0.018 mg/L, respectively.

An analytical summary of detected analytes is provided in Table 2.

2.3 Summary of Analytical Results

Based on the EP Toxicity testing of the samples collected in 1984, the materials do not meet TCLP criteria. The samples were reanalyzed in 1985 and again did not meet TCLP criteria.

Total Constituent analysis detected some metals, cyanide, and oil & grease.

Both the groundwater trends and the recent data collected in 2001 show, in general, a decrease or constant concentration of the majority of the analytes detected over time. However, the potential main constituents in SPL are chromium and lead, and chromium has been detected in both the total and dissolved metals analysis.

As noted in Section 1.2, historical documents obtained by regulatory agencies, including USACE show that dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA including the area immediately under SWMU S-16. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater zone 3, 4, and 5 is further assessed in the RFI. Because of the USACE dredge spoils, the contribution of this particular SWMU to groundwater contamination within the sand unit is not known.

Further evaluation of the SWMU S-16 materials and the groundwater within Zone 4 is provided in Section 3.0.

3.0 RISK ASSESSMENT

A human health risk assessment, as described in the *Human Health Risk Assessment* Work Plan (BSC 1997a), was conducted for SWMU S-16, Lime Stabilized Pickle Liquor Sludge/Slag Landfill. The results of the Tier I Human Health Risk Assessment (HHRA) are presented here and are organized into the following sections: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization and Uncertainty Analysis. The major components of this HHRA have previously been presented in Human Health Risk Assessment Report, Part IV of this RFI Report. Therefore, the following sections provide summary overviews of previously presented information. This section, therefore, serves as a summary report, bringing together all associated and related work from previous risk assessment deliverables, and providing the conclusions of the SWMU-specific risk assessment

3.1 <u>Data Evaluation</u>

A list of 96 constituents of potential interest (COPIs) was developed for the BSC Lackawanna, New York facility based on USEPA and industry studies (BSC 1998). The list contains hazardous constituents that could be present in the waste streams as a result of integrated iron and steel plant operations, such as those historically conducted at the Lackawanna facility. The Human Health Risk Assessment ID No. 1 (BSC 1998) established the chemicals of potential concern (COPCs) for each SWMU at the Lackawanna Facility. The COPCs were determined by sequentially applying the following criteria, as applicable, to each COPI on a medium-by-medium basis for each SWMU: 1) the chemical was detected in at least 5% of the samples, 2) the chemical was detected in at least one sample at levels above background (*i.e.*, the maximum concentration was above background for chemicals in surficial SWMU material only) and 3) the chemical was positively detected in at least one sample at levels above applicable screening criteria [*i.e.*, the maximum concentration was greater than the screening criteria: USEPA Region III Risk Based Concentrations (RBCs), USEPA Soil Screening Levels (SSLs), or NYSDEC Ambient Water Quality Standards and Guidance values]. In accordance with ID No. 1, a background comparison was not made for the subsurface SWMU material.

The sampling data for SWMU S-16 (as presented in Section 2.0 of this report) were evaluated in order to identify the site-related COPCs for the SWMU. COPCs were originally determined in ID No. 1, however, as some screening criteria have been revised since ID No. 1 was submitted, this screening process was updated and is presented in Tables 3 and 4. No surface SWMU material samples have been collected from SWMU S-16 and analyzed for total constituents. The SWMU is presently covered with a geotextile membrane precluding direct contact with surface material. Table 3 presents the screening of the subsurface SWMU material and Table 4 presents the screening of groundwater. There were no COPCs identified in subsurface SWMU material and fourteen volatile organic COPCs were identified in groundwater. Representative concentrations were then determined for each COPC; these representative concentrations are presented in Table 5. It should be noted that the subsurface data are limited to metal analyses. SWMU S-16 is located in Groundwater Zone 4 (BSC 1998). As more than ten groundwater samples have been collected, the 95% UCL was used as the representative concentration for each of the COPCs. If a dataset would have had a sample size of less than 10, the maximum detected concentration would have been used. The groundwater COPCs and their representative concentrations are presented in Table 5; these concentrations are used in the SWMU S-16 risk characterization.

3.2 Exposure Assessment

The exposure assessment conducted for SWMU S-16 included a review of current and future human receptor scenarios and potential exposure pathways, as related to COPCs. In general, exposure pathways by which a human receptor could come into contact with SWMU material are defined by four components (USEPA 1989):

- A source and mechanism of constituent release to the environment;
- An environmental transport mechanism;
- A point of potential human contact with the affected medium, and
- A route of entry into humans.

If any one of these components is missing, the pathway is considered incomplete and does not contribute to receptor exposure.

Human Health Risk Assessment ID No. 2 (BSC 1999b) presented the current and future human receptor scenarios and potentially complete exposure pathways for each of the SWMUs identified at the Lackawanna Facility. ID No. 1 (BSC 1998) identifies the COPCs; these COPCs were also integral in determining complete exposure pathways, based on their presence in each media (*i.e.*, surface SWMU material, subsurface SWMU material or groundwater) and their volatility (*e.g.*, inorganics in groundwater do not present a complete exposure pathway as they are not volatile and groundwater is not used as a drinking water source). Potential exposure pathways for S-16 are presented in Table 6 and discussed below.

For SWMU S-16, the potential receptor scenarios include a future commercial/industrial worker, scenario, a future construction worker scenario, a future utility/maintenance worker scenario, and a trespasser scenario. Potentially complete exposure pathways were previously established in ID No. 2 for each receptor, and are summarized below. Scenarios were developed based on current land use patterns, unrestricted future commercial/industrial development, and potential future recreation uses.

For the future commercial/industrial worker scenario, the future utility/maintenance worker scenario, the future construction worker scenario and the trespasser scenario, inhalation of vapors from Groundwater Zone 4 was determined to be the only complete exposure pathway. The future commercial/industrial worker scenario may also be potentially exposed to indoor vapors from groundwater, should a building be placed on the site under current conditions. Direct contact pathways are incomplete because of the geomembrane cover on this SWMU.

3.3 Toxicity Assessment

A toxicity assessment characterizes the relationship between the exposure to a COPC and the frequency of adverse health effects that may result from such an exposure (dose-response). The end result of the dose-response assessment is the determination of human uptake levels that provide an adequate measure of protection to exposed persons for carcinogenic and noncarcinogenic endpoints. The derivation of acceptable levels of exposure (*e.g.*, risk-based screening levels; RBSLs) and the manner in which these levels are used in this HHRA are discussed below.

Tier I RBSLs were calculated and compared to the representative SWMU S-16 COPC concentrations. RBSLs are defined as concentrations of COPCs in media that are not expected to produce any adverse health effects under chronic exposure conditions. Tier I RBSLs were developed using information previously defined and described in detail in the Work Plan and ID No. 2; this information is summarized here. The equations used to calculate the RBSLs follow basic USEPA risk assessment principles (USEPA 1989; 1996). Conservative exposure parameters, as defined by the ASTM Standard (ASTM 1995) and USEPA guidance (USEPA 1989, 1991a, and 1991b), and USEPA toxicity criteria (USEPA 2000); were input into these equations to develop the RBSLs. As some of the toxicity criteria have been revised by the USEPA since originally presented in ID No. 1, the criteria for all chemicals have been re-presented in Table 7 of this HHRA. The above information was used to calculate Tier 1 RBSLs for COPCs in SWMU material and groundwater, for each of the four exposure scenarios.

A comparison of the representative COPC concentrations to RBSLs for each of the exposure scenarios is presented in Table 8. This comparison provides a preliminary screening of potential risk to the specific receptor populations and exposure pathways identified for this SWMU. It should be noted that many of the groundwater RBSLs calculated were greater than the chemicals' solubility in water. This indicates that, based on the predicted amount of chemical volatilization, pure product in the groundwater would not pose a health threat from these chemicals. In such cases, the solubility limits of these chemicals are indicated in Table 8.

For all scenarios, chemicals, and pathways, the representative groundwater concentrations are below their respective RBSLs. In accordance with Part IV of this RFI report, no further evaluation is necessary.

3.4 Conclusion

The results of the Tier 1 HHRA are that no chemicals in subsurface SWMU material or Zone 4 groundwater exceed any of the calculated RBSLs. Based on these results and in accordance with the work plan, further evaluation is not warranted during the Corrective Measures Study (CMS).

The uncertainties inherent in the conclusions are presented in the following Uncertainty Analysis.

3.5 Uncertainty Analysis

3.5.1 Sampling Data

Multiple sources of uncertainty can be identified for any risk assessment. These include, among others, uncertainty associated with the toxicity criteria used to derive dose-response factors, uncertainties associated with exposure parameters used in the exposure assessment, and uncertainties associated with combining exposure parameters and toxicity criteria to characterize risk.

3.5.2 Exposure

In the development of any health assessment, some level of uncertainty is introduced each time an assumption is relied upon to describe a dynamic parameter. Some assumptions have a significant scientific basis while others do not, which may result in the selection and use of conservative, default exposure parameters in the exposure assessment. The selection of multiple conservative assumptions in the exposure assessment generally results in an overestimation of potential health risks associated with exposure to specific chemical constituents.

3.5.3 Toxicity Assessment

Noncarcinogenic Criteria- Toxicity information for many of the COPCs is limited for humans. Consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty will be associated with the calculated toxicity values. The USEPA derives reference concentrations (RfC; inhalation exposures) and reference doses (oral exposures) for chemicals using an uncertainty factor (UF) approach. The uncertainty factor for naphthalene, for instance, is 3000. This was derived by applying a UF of 10 to account for extrapolation of the mouse study to humans, another UF of 10 to account for sensitive humans, another UF of 10 to account for extrapolation from a Lowest Observed Adverse Effect Level (LOAEL) to a No Observed Adverse Effect Level (NOAEL), and a final UF of 3 to account for lack of an appropriate reproductive study. In general, the procedures used to extrapolate from animals to humans in toxicity studies include a conservative use of uncertainty factors so that potential effects on humans are likely overestimated rather than underestimated. It is widely accepted in the scientific community that low doses of toxicants may be detoxified by any one of several processes present in human organ systems (Ames, *et al.* 1987). As a result, humans may not react to the same degree as the population of genetically homogeneous laboratory animal populations used in standard bioassays.

Carcinogenic Criteria- USEPA cancer SFs are developed using variations of the Linear Multistage Model (LMS) for carcinogenicity. The LMS is highly conservative as it assumes linearity between dose and effect to zero dose assuming no threshold for carcinogenicity. However, the human body has mechanisms to detoxify most chemicals particularly at low doses, and therefore many scientists believe that most, if not all carcinogens only cause cancer above a "threshold dose."

One of the carcinogenic COPCs evaluated for this SWMU was benzene. The inhalation slope factor for benzene is based on human data from occupational exposure studies, and thus an extrapolation from animal data is not necessary, thereby reducing the some uncertainty in the slope factors. However, there is significant uncertainty associated with the low-dose extrapolation (environmental exposures are relevant in the low-dose range) used to generate the slope factor. The USEPA has used its default linear model to estimate risks in the low dose range citing lack of carcinogenic mode of action information. Thus, should this information become available, the low dose carcinogenic risks for benzene may be evaluated differently.

Absence of Inhalation Toxicity Criteria - Although toxicity information is generally available for the most significant chemicals and exposure routes in this HHRA, there were some volatile COPCs in this HHRA for which no inhalation toxicity criteria (RfDs or cancer slope factors) exist. In the absence of data, either the oral RfD or oral SF was used to evaluate inhalation exposures. The letter "R" on Table 7 notes these instances. It is more conservative to evaluate these chemicals for inhalation exposures than to not evaluate them at all. Thus, this method potentially overestimates inhalation risks for COPCs evaluated as such.

3.5.4 Risk Characterization

Uncertainties in the risk characterization portion of the risk assessment for the facility are a combination of the uncertainties associated with both the dose-response assessment and the exposure assessment. As discussed above, the assumptions and parameters used for both the dose response and exposure assessments are extremely conservative. In addition, since the toxicity criteria and exposure parameters are combined in the risk characterization, the conservatism is compounded.

3.5.5 Uncertainty Analysis Summary

This Tier I HHRA includes uncertainties and conservative assumptions that, in general, effectively combine to overestimate the potential current and future exposures. The major sources of uncertainty contributing to the conservatism in this HHRA are summarized below:

- Compounding effect of multiple conservative exposure parameters
- Confidence in toxicity criteria

The net effect of the uncertainties of this HHRA is the generation of risk and hazard estimates that probably far exceed any true exposure conditions that currently exist or which could possibly exist in the future.

4.0 CONTAINMENT

SWMU S-16 was placed directly on slag fill. There is no liner or other engineering containment structure under the landfill. There is a 30 MIL thick geomembrane cover on top of the landfill that prevents rainwater contact with the SPL. The geomembrane is also contoured in such a manner that no rainwater accumulates on the cover. There are no exposure pathways for ingestion, inhalation, or dermal contact from the SWMU material.

SWMU S-16 is surrounded on the north, east, and south by SWMU S-23, which retards surface runoff from leaving the SWMU site. The topography of the site is such that surface water drains toward the western portion of the site, into a gravel covered drain pipe and eventually infiltrates through the slag material south of SWMU S-16.

5.0 CONCLUSIONS

Based on review of the data, the following conclusions can be made.

- Spent pickle liquor was last placed in SWMU S-16 in 1982. The landfill, which has been covered with a geomembrane cover, has been closed on an interim basis pending a final decision on the 1985 Delisting petition.

- Dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-16. Because of the dredge spoils, the contribution of this particular SWMU to groundwater contamination within the sand unit is not known.

- Analysis of waste samples collected in 1984 from the landfill disclosed that seven metals (arsenic, barium, cadmium, total chromium, lead, mercury, and selenium) were present above method detection limits in the extracts of the composite subsurface waste samples. However, the concentrations of these metals did not meet TCLP criteria. No VOC or SVOC analysis was conducted.

- Due to the presence of a groundwater mound within the fill unit in the vicinity of SWMU S-16/S-23, no wells in the vicinity of the SWMU S-16/S-23 can accurately be described as being upgradient. Groundwater downgradient of the SWMU S-16 contains detectable concentrations of VOCs, SVOCs, and metals. SWMU S-23, adjacent to SWMUS-16, is known to contain VOCs, and SVOCs (as discussed in a separate report).

- The impacts of SWMU S-16 to the groundwater cannot be determined due to the groundwater mound and proximity of SWMU S-23 to S-16. However, it can be noted that barium and chromium have shown an increase in concentration over time in two of the downgradient wells.

- Groundwater lies approximately 9 feet below the floor of the landfill. The landfill construction methods and the geomembrane cover prevent exposure pathways via ingestion, inhalation, and dermal contact from the SWMU material.

- The results of the Tier 1 HHRA are that no metals in subsurface SWMU material or Zone 4 groundwater exceed any of the calculated RBSLs.

The presence of several metals within the downgradient groundwater may be related to SWMU S-16. Due to the lack of VOC or SVOC data from SWMU material, it cannot be fully determined if SWMU S-16 has had an additive effect on organic groundwater constituents. These constituents may also be related to the adjacent materials in SWMU S-23. The presence of the geomembrane cover, installed as part of an interim closure, precludes any additional sampling. Any further evaluation of this SWMU, including the status of the delisting petition will be completed during the CMS phase.

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SWMU ASSESSMENT REPORT
VACUUM CARBONATE BLOWDOWN LANDFILL Q
(SWMU S-17)

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SEPTEMBER 2004

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FIGURES
(Following Text)

Figure 1 Site Location Map for Vacuum Carbonate Blowdown Landfill Q (SWMU-17)

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1.0 INTRODUCTION

This report documents the results of an environmental assessment of the Vacuum Carbonate Blowdown Landfill Q at Bethlehem Steel Corporation's (BSC), Lackawanna, New York facility. The Vacuum Carbonate Landfill Q was identified as Solid Waste Management Unit (SWMU) S-17 by the United States Environmental Protection Agency (USEPA) in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA), (USEPA 1988). The USEPA required a RCRA Facility Investigation (RFI) of SWMU S-17 and other SWMUs at the BSC facility be completed in accordance with the Administrative Order of Consent (AOC) signed by BSC and the USEPA in 1990 (USEPA 1990). The RFI has been conducted in phases (Phase I, IIA, IIB, IIC, and III). The RFI included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. This report evaluates SWMU data available to BSC as of November 2001.

1.1 Description

SWMU S-17 is located in the central part of Zone 4 of the Slag Fill Area (SFA) at BSC's Lackawanna facility as shown on Figure 1. SWMU S-17 covers an area of approximately 0.2 acres. The site consists of two parallel, northwest-southeast oriented trenches that are approximately 300 feet long. The trenches are about 6 to 10 feet wide, with an irregular bottom and about 2 to 4 feet deep. A railroad bed separates the east and west trenches. A second railroad bed borders the eastern trench. The steel rails and many of the wooden ties have been removed from the railroad beds, which are elevated about 3 to 4 feet above the trenches. The western side of SWMU S-17 is bounded by piles of slag gravel elevated about 3 feet to 10 feet above SWMU S-17. The two trenches terminate in the north at the base of a slag pile. An unpaved access road curves around SWMU S-17 along the west, north and east sides. Scattered shrubs and small trees cover approximately 75 percent of SWMU S-17.

1.2 History

Landfill Q operated from the early 1960's to 1983. The two trenches were reportedly used as a disposal area for "vacuum carbonate blowdown solution". This solution was a liquid waste from a coke oven gas desulfurization process called the Koppers process. This process purified off-gas from the coke ovens for reuse at the Plant as fuel. In the Koppers process, a sodium carbonate solution (soda ash and water) was circulated through a closed loop system. Compressed acidic oven gases containing hydrogen sulfide were introduced and absorbed into the circulating carbonate solution. The carbonate solution was then heated and pumped to a stripper tower where hydrogen sulfide gas was extracted under vacuum. The carbonate solution was reused until its specific gravity exceeded process tolerances. At that point, the process was shut down and the spent solution (referred to as "vacuum carbonate blowdown solution") was washed out of the system.

The spent carbonate solution was collected and temporarily stored in railroad tank cars. One tank car was used to collect concentrated solution, and a second car was used to contain rinse water generated during the blowdown operations. The tank cars were moved from the stripper tower to Landfill Q where the spent carbonate solution was placed in the trenches. The amount of waste material placed in the landfill during 20 years of operation is unknown.

Vacuum carbonate solution was typically a dark gray-black colored solution containing sodium carbonate, and at times, low concentrations of cyanide and hydrogen sulfide. Under normal operating conditions, the solution did not exhibit hazardous characteristics; however, trace levels of benzene may have been present. BSC analytical data of the spent solution showed percent levels of thiocyanate and low levels (milligrams per liter) of cyanide and selenium (EPA NEIC, 1988). Mercury was once detected in the solution. The source of the mercury was identified as the mercury manometers used to monitor process pressures. They were later replaced with non-mercury manometers. Landfill Q was classified as a SWMU because of the characteristics of the spent carbonate solution.

In 1983, the vacuum carbonate solution was no longer disposed of at SWMU S-17. The waste was mixed with weak ammonia liquor from the coke ovens and was treated at the Erie County #6 Waste Water Treatment Plant (POTW). In the late 1980s, the vacuum carbonate solution was not sent to the POTW because of high thiocyanate levels. The material was stored onsite until 1991 when it was shipped to an approved waste disposal facility. The vacuum carbonate solution was disposed off-site until 1994 when the desulfurization process was shutdown.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers show that the dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area immediately under SWMU S-17. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI. The contribution of this particular SWMU to groundwater contamination cannot be evaluated.

On February 20, 1996, BSC filed a declaration in the Erie County, New York Clerk's office limiting future use of the property including SWMU S-17. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevents installation and operation of extraction or water wells for purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants, and Restrictions is included as Attachment A.

A site inspection in September 1996 by Dames & Moore found no evidence of surface water runoff from the trenches. On April 11, 2001, URS personnel inspected SWMU S-17. The inspection found the site as described above. The field notes for the 2001 SWMU inspection are provided in Appendix A.

2.0 SAMPLING AND ANALYSIS

In order to characterize the materials placed in SWMU S-17, exploratory trenching, boring and sampling of the unit was performed during 1993, 1994, and 2000. Waste samples were collected in 1993, 1994 and 2000. Sampling was conducted in accordance with the Phase IIA (BSC 1992), Phase IIB (BSC 1993) and the Supplemental SWMU Assessment Work Plan (BSC 2000). A complete list of site-specific compounds targeted for analysis in the site investigations is provided in Table 1, followed by laboratory data qualifiers. Laboratory analytical reports are provided in Section II of the RFI.

SWMU S-17 is located within groundwater monitoring Zone 4. Three groundwater units are present beneath Zone 4; the fill unit, the sand unit and the bedrock unit. Figures 2 and 3 show groundwater contours near SWMUS-17 for the fill and sand units, respectively. There are no groundwater monitoring wells upgradient or downgradient of SWMU S-17. The nearest well, MWN-12 is located southwest of SWMU S-17. The well is downgradient of a groundwater mound beneath SWMU S-23 and S-16. SWMU S-16 is a NYSDEC-permitted hazardous waste management unit (HWM). Additionally, as stated in Section 1.2, SWMU S-17 and MWN-12 are located within the former U.S. Army Corps of Engineers dredge spoils disposal area. Since the adjacent SWMU S-23 may affect water quality within MWN-12 and there are no wells that monitor the direct impact of SWMU S-17 on groundwater quality, the impact of SWMU S-17 on local groundwater cannot be assessed. Furthermore, due to groundwater impacts from SWMUs S-16/S-23 and groundwater mound, additional wells around SWMU S-17 are likely to be impacted by SWMUs S-16/S-23 and would not provide further useful data for groundwater impacts from SWMU S-17.

Although the potential contribution to groundwater from SWMU S-17 cannot be evaluated, groundwater contamination present beneath Zone 4 will be evaluated with respect to pathways relevant to SWMU S-17 in the Human Health Risk Assessment presented in Section 3.0.

Groundwater was sampled from wells located near SWMU S-17 by BSC from 1986 to 1988. Groundwater sampling resumed during the four phases of the RFI starting in 1991 and continued into 2000. Groundwater sampling was conducted during Phase I (1989, revised 1990), Phase IIC (BSC 1994), the Comprehensive Well Sampling Program (BSC 1999a) and the Supplemental SWMU Investigation (BSC 2000) in accordance with work plans approved for each of the four phases by USEPA.

2.1 1993 Phase IIA Sampling

On January 13 and 14, 1993 sixteen test pits were excavated to define the horizontal and vertical extent of the landfill area. The test pits were excavated up to 9 feet below the ground surface in the railroad beds and trenches. Three distinct layers of fill material were observed in the 1993 excavations.

The upper layer consisted of 8 to 12-inches of a brown to dark brown clayey silt, with silty sand and a trace of fine gravel-sized material. The upper layer was exposed in each of the test pits and appeared to cover the entire SWMU area.

The second layer was approximately 2 to 3 feet in thickness and consisted of white to light gray, fine to medium grained slag gravel, with light gray silty clay and a gray, coarse-grained silty slag sand (slag fill).

The third layer was approximately 2.5 feet in thickness and consisted of gray to light gray, fine to coarse grained slag gravel, silty clay and coarse-grained, silty slag sand (slag fill) with slight stratification. The third layer was extremely hard and difficult to excavate.

No samples were collected from the sixteen test pits excavated.

On February 26, 1993, a sample was collected from test pit, S-17-01 (excavated in January). Samples of solid phase material were collected from the test pit from six distinct locations: one from a vein of dark gray sludge located near the base of the upper layer; two from different depths within the second layer; and three from different depths within the lower layer. The six samples were homogenized to form one composite sample, (S17) that was subsequently processed by the Toxicity Characteristic Leaching Procedure (TCLP). The TCLP extract was analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. No sample records were available for this sample.

2.2 1994 Phase IIB Sampling

On June 9, 1994 soil borings were advanced and soil samples were collected in the easternmost trench in two separate locations. A CME 850-drill rig was used to drive a split-barrel sampler through 2-1/4 inch inside diameter hollow stem augers. Split-spoon samplers were driven to depths of 3 feet below the bottom of the trench, in two separate, small sampling areas of approximately 10 square feet, to collect and composite the samples. The sample locations (S17-1 and S17-2) are shown on Figure 1. One sample and a duplicate sample (SWMU-S17-1 and SWMU-S17-1-DUP) were collected from the northern portion of the trench and one sample (SWMU-S17-2) was collected from the southern end of the trench. A grab sample from each location was submitted for VOC analysis and composite samples, representative of each 10 square foot sampling location, were analyzed for SVOCs, metals, and cyanide. Analyses included total constituent analysis and sample processing by TCLP and the Synthetic Precipitation Leaching Procedure (SPLP). The TCLP extract was analyzed for VOCs, SVOCs and metals, and the SPLP extract was analyzed only for metals.

2.3 2000 Supplemental Sampling

On December 28, 2000, two test pits, TP-01 and TP-02, were excavated across the north and south ends of the SWMU, respectively, as shown in Figure 1. The three layers of soil noted in the 1993 test pits were observed in the 2000 test pits along with a fourth soil layer. The fourth layer thickness could not be determined and only one foot of the fourth layer was exposed. The material consists of brown to dark brown, medium to coarse sand and fine to medium gravel.

Two grab samples [TP-01 (7-8') and TP-02 (6-7')] were collected from the fourth layer; one sample was collected from TP-01 and the second sample was collected from TP-02. The samples were analyzed for VOCs, SVOCs, metals, chloride, sulfate, cyanide, total recoverable phenolics, total organic carbon (TOC), total organic halogens (TOX), and sample processing by

TCLP and SPLP. The resulting TCLP and SPLP extracts were analyzed for VOCs, SVOCs, and metals. Sample records are provided in Appendix B.

2.4 Analytical Results

2.4.1 Total Constituent Results

Soil samples collected from the 1993 sample event were not analyzed for Total Constituent analysis.

Seven VOCs, twelve SVOCs, and ten metals were detected in the 1994 samples. VOCs detected ranged from 3.3 micrograms per kilogram (ug/kg) of toluene in S17-2 to 37 ug/kg of 1,1,1-trichloroethane in S17-1. SVOCs ranged from 470 ug/kg of naphthalene in S17-1 to 3,800 ug/kg of benzo(b)fluoranthene in S17-1. Metals ranged from .067 milligrams per kilogram (mg/kg) of selenium to 103 mg/kg of barium, both detected in S17-2. Cyanide was also detected in the samples ranging from 0.54 mg/kg in S17-1 to 1.4 mg/kg in S17-1 (DUP).

Nine SVOCs and fourteen metals were detected in the 2000 samples. No VOCs were detected. SVOCs ranged from 34 ug/kg of naphthalene in TP-01 to 600 ug/kg of phenanthrene in TP-02. Metals ranged from 0.56 mg/kg of mercury in TP-02 to 186 mg/kg of barium in TP-01. Leachable cyanide ranged from 0.23 milligrams per liter (mg/L) in TP-02 to 0.25 mg/L in TP-01. Analytical results are presented in Table 2.

2.4.2 SPLP Results

SPLP analyses were conducted to more closely mimic the effect of compounds leaching from soil due to rainwater infiltration. The analyses were performed in accordance with the USEPA's SW 846 Method 1312 protocols. The SPLP results help evaluate what compounds can potentially leach from the soils and effect groundwater quality.

SPLP analysis was not performed on the 1993 soil samples. No metals were detected in the SPLP extraction of the 1994 soil samples.

In the December 2000 soil samples, five VOCs, one SVOC, and eight metals were detected in the SPLP extract. VOCs ranged from 0.0019 mg/L of methylene chloride (which was also detected in the total constituent analysis (TP-02) to 0.008 mg/L of m-xylenes & p-xylene (TP-02). The SVOCs, phenanthrene was detected at 0.004 mg/L (TP-02). Metals ranged from 0.000077 mg/L of mercury (TP-01) to 0.36 mg/L of magnesium (TP-01). Cyanide was not detected in the SPLP analysis. Analytical results for the SPLP analyses are presented in Table 2.

2.4.3 TCLP Results

TCLP results were compared to regulatory concentration levels listed in 40 CFR Part 261. The TCLP extract concentrations indicate that the materials in SWMU S-17 do not meet TCLP criteria. TCLP analytical results and regulatory levels are provided in Table 3.

Three VOCs, four SVOCs, and one metal were detected in the 1993 sample (S17). VOCs ranged from 0.01 milligrams per liter (mg/L) of total xylenes to 0.31 mg/L of trichlorofluoromethane. SVOCs ranged from 0.018 mg/L of pyridine to 0.045 mg/L of phenanthrene. The metal detected was barium at 0.231 mg/L.

Only one metal, barium, was detected in the TCLP extraction of the 1994 soil boring samples. Barium ranged from 0.25 mg/L in S17-1 (0.26 mg/L in the DUP sample) to 0.26 mg/L in S17-2. No VOCs or SVOCs were detected in the samples.

Two SVOCs and eight metals were detected in the 2000 test pit samples. SVOCs ranged from 0.0049 mg/L of fluoranthene in to 0.022 mg/L of phenanthrene, both detected in TP-02. Metals ranged from 0.000045 mg/L of mercury in TP-02 to 0.31 mg/L of barium in TP-01.

2.5 Summary of Analytical Results

Totals analysis indicates several VOCs, SVOCs, and metals were detected at low concentrations in the samples collected from SWMU S-17.

SPLP analysis indicates that that material in SWMU S-17 may have the potential to leach some hazardous constituents, but the concentrations within the leachate were generally low.

TCLP analysis indicates that the material stored in SWMU S-17 does not meet TCLP criteria.

The impact of SWMU S-17 on groundwater cannot be evaluated due to the proximity of SWMU S-16 and SWMU S-23. Furthermore, due to groundwater impacts from S-16/S-23 and groundwater mound, additional wells around SWMU S-17 are likely to be impacted by S-16/S-23 and would not provide further useful data for groundwater impacts from SWMU S-17. The presence of the former US Army Corps of Engineers dumping grounds, as discussed in Section 1.2, may have also affected groundwater beneath the area of SWMU S-17.

Additional evaluation of the risk from both the soil and Zone 4 groundwater is provided in the Section 3.0.

3.0 RISK ASSESSMENT

A human health risk assessment, as described in the *Human Health Risk Assessment Work Plan* (BSC 1997), was conducted for SWMU S-17, Vacuum Carbonate Blowdown Landfill Q. The results of the Tier 1 Human Health Risk Assessment (HHRA) are presented here and are organized into the following sections: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization and Uncertainty Analysis. The major components of this HHRA have previously been presented in Human Health Risk Assessment Report, Part IV of this RFI Report. Therefore, the following sections provide summary overviews of previously presented information. This section, therefore, serves as a summary report, bringing together all associated and related work from previous risk assessment deliverables, and providing the conclusions of the SWMU-specific risk assessment.

3.1 Data Evaluation

A list of 96 constituents of potential interest (COPIs) was developed for the BSC Lackawanna site based on USEPA and industry studies (BSC 1998). The list contains hazardous constituents that could be present in the waste streams as a result of integrated iron and steel plant operations, such as those historically conducted at the Lackawanna facility. Human Health Risk Assessment ID No. 1 (BSC 1998) established the chemicals of potential concern (COPCs) for each SWMU at the Lackawanna Facility. The COPCs were determined by sequentially applying the following criteria to each COPI on a medium by medium basis for each SWMU and watercourse: 1) the chemical was detected in at least 5% of the samples, 2) the chemical was detected in at least one sample at levels above background (*i.e.*, the maximum concentration was above background; for chemicals in surficial SWMU material only), and 3) the chemical was positively detected in at least one sample at levels above applicable screening criteria [*i.e.*, the maximum concentration was greater than the screening criteria: USEPA Region III Risk Based Concentrations (RBCs), USEPA Soil Screening Levels (SSLs), or NYSDEC Ambient Water Quality Standards and Guidance values]. In accordance with ID No. 1, a background comparison was not made for the subsurface SWMU material in this report.

The sampling data for SWMU S-17 (as presented in Section 2.0 of this report) were evaluated in order to identify the site-related COPCs for the SWMU. The COPCs were originally determined in ID No. 1, however, as some screening criteria were revised since ID No. 1 was submitted, and because new groundwater samples have also been collected, this screening process was updated (Tables 4 and 5). Table 4 presents the screening of the subsurface SWMU material, and Table 5 presents the screening of groundwater. Because only subsurface material samples were obtained for SWMU S-17, COPCs and representative concentrations in subsurface material were also used to represent surface material. In SWMU material, five semivolatile organic chemicals (all PAHs), and four inorganic chemicals (arsenic, chromium, mercury, and thallium) were identified as COPCs. SWMU S-17 is located in the Zone 4 groundwater area, for which fourteen volatile organic and volatile semivolatile organic chemicals were identified as COPCs.

Representative concentrations were then determined for each COPC. For COPCs with data set sample sizes of ten or greater, the 95% upper confidence limit of the mean (95% UCL) was calculated and used as the representative concentration for that COPC. For COPCs with sample sizes of less than ten, the maximum concentration was used. Between one and four samples were collected for subsurface material constituents in SWMU S-17, therefore, maximum concentrations were used. As all of the COPCs data sets in Zone 4 groundwater have at least 10 samples, the 95% UCL was used as the representative concentration for each of the groundwater COPCs. The representative concentrations for the COPCs in this HHRA are presented in Table 6. If a chemical's representative concentration exceeds its saturation limit in soil, or its solubility limit in groundwater, it is noted in Table 6. This may indicate the presence of free product.

3.2 Exposure Assessment

The exposure assessment conducted for SWMU S-17 included a review of current and future human receptor scenarios and potential exposure pathways, as related to COPCs. In general, exposure pathways by which a human receptor could come into contact with SWMU material are defined by four components (USEPA 1989):

- A source and mechanism of constituent release to the environment,
- An environmental transport mechanism,

- A point of potential human contact with the affected medium, and
- A route of entry into humans.

If any one of these components is missing, the pathway is considered incomplete and therefore does not contribute to receptor exposure.

Human Health Risk Assessment ID No. 2 (BSC 1999b) presented the current and future human receptor scenarios and potentially complete exposure pathways for each of the SWMUs identified at the Lackawanna Facility. For SWMU S-17, the potential receptor scenarios include a current non-BSC commercial/industrial worker, a future commercial/industrial worker, a future construction worker, a future utility/maintenance worker, a trespasser, a future marina worker, a future greenway user, a future fenceline resident, and a present fenceline resident. Potentially complete exposure pathways were established for each receptor. For the future commercial/industrial workers and the trespasser scenarios, the following pathways were determined to be complete: direct contact (*i.e.*, ingestion or dermal contact) with surface SWMU material, inhalation of airborne particulates from uncovered surface SWMU material, or inhalation of vapors from Zone 4 groundwater. These pathways also apply for the construction worker and the utility/maintenance worker scenarios; however, these workers may additionally be exposed to subsurface SWMU material during potential future digging activities. For the future industrial/commercial worker scenario, inhalation of indoor vapors from groundwater was also evaluated as if there was a building on site. For the current non-BSC commercial/industrial worker, marina worker, greenway user, and residential, inhalation of particulates in surficial SWMU material is the only complete exposure pathway evaluated in this SWMU-specific risk assessment.

A detailed description of the potentially exposed receptor scenarios and pathways for SWMU S-17 can be found in ID No. 2 (BSC 1999b), and a summary is provided in Table 7.

3.3 Toxicity Assessment

A toxicity assessment characterizes the relationship between the exposure to a COPC and the frequency of adverse health effects that may result from such an exposure (dose-response). The end result of the dose-response assessment is the determination of human uptake levels that provide an adequate measure of protection to exposed persons for carcinogenic and noncarcinogenic endpoints. The derivation of acceptable levels of exposure (*e.g.*, risk-based screening levels) and the manner in which these levels are used in this HHRA are discussed below.

Tier 1 risk-based screening levels (RBSLs) were calculated and compared to the representative SWMU S-17 COPC concentrations. The RBSLs are defined as concentrations of COPCs in media that are not expected to produce any adverse health effects under assumed exposure conditions. Tier 1 RBSLs were developed using information previously defined and described in detail in the Work Plan and ID No. 2; this information is summarized in this HHRA. The equations used to calculate the RBSLs follow basic USEPA risk assessment principles (USEPA 1989; 1996). Conservative exposure parameters, as defined by the ASTM Standard (ASTM 1995) and USEPA guidance (USEPA 1989, 1991a, and 1991b), and USEPA toxicity criteria (USEPA 2000a), were input into these equations to develop the RBSLs. As some of the toxicity criteria were revised by the USEPA since originally presented in ID No. 1, they are presented in Table 8 of this HHRA. The direct contact RBSLs for the construction worker and utility/maintenance work were calculated using the subchronic RfDs for chromium and thallium. The above information was used to calculate Tier 1 RBSLs for COPCs in SWMU material and groundwater, for each of the nine exposure scenarios (Table 9).

It should be noted that, in groundwater, some of the RBSLs calculated were greater than the chemicals' solubility in water. This indicates that, based on the predicted amount of chemical volatilization, pure product in the groundwater would not pose an inhalation health threat from these chemicals. The solubility limits of these chemicals are indicated in Table 9. Also, some of the RBSLs for COPCs in SWMU material were determined to be health protective at levels that are greater than 1,000,000 parts per million (mg/kg); such cases are noted by the following indicator ">1,000,000" in Table 9.

A comparison of the representative COPC concentrations to RBSLs for each of the exposure scenarios is presented in Table 9. This comparison provides a preliminary screening of potential risk to the specific receptor populations and exposure pathways identified for this SWMU. For the future commercial/industrial worker scenario, representative concentrations of chromium, mercury, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene in SWMU material exceed their respective direct contact RBSLs. For the future construction worker scenario, the concentration of benzo(a)pyrene exceeds the direct contact RBSL. For all other scenarios, chemicals and pathways, the representative concentrations are below the respective RBSLs.

In accordance with Part IV of this RFI report, those COPCs that do not exceed the Tier 1 RBSLs are not evaluated further. For those COPCs that exceed Tier 1 RBSLs, the risk to human health is evaluated further using a Tier 1 HHRA.

3.4 Risk Characterization

Risk characterization involves estimating the magnitude of potential adverse health effects of the COPCs, and summarizing the nature of the health impact to the defined receptor populations. It combines the results of the toxicity and exposure assessments to provide numerical estimates of health risk.

The Risk Characterization, or Tier 1 HHRA, provides an estimate of risk and hazard based on a comparison of the RBSL (*i.e.*, health-protective levels) to the COPC concentrations (*i.e.*, site-specific levels). Specifically, for those COPCs that exceeded an RBSL, a screening-level hazard index (SLHI) was calculated to evaluate noncarcinogenic health effects, and a total screening-level cancer risk ($SLCR_{total}$) was calculated to evaluate carcinogenic effects. The SLHI and $SLCR_{total}$ methodologies are presented in the Work Plan (BSC 1997). The Tier 1 HHRA results are presented in Table 10.

3.4.1 Noncarcinogenic Hazards

The noncancer hazards were assessed in this HHRA using a hazard quotient approach (USEPA 1989). For each COPC, the noncarcinogenic RBSL was compared to the COPC's representative concentration to determine the screening level hazard quotient (SLHQ) for that chemical. The equation is as follows:

$$SLHQ = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}}$$

SLHQs for each chemical are summed to create a total Screening Level Hazard Index ($SLHI_{total}$) for each pathway. The smaller the SLHQ/SLHI, the greater the degree of protection for that pathway. Based on USEPA methodology (USEPA 1989) and as discussed in the Work Plan, if the SLHI is less than 1, the risks are considered to be negligible. Those total SLHIs that exceed 1 were further evaluated by developing target organ-specific SLHIs. This process is appropriate as only certain chemicals affect similar biological target endpoints, and it is only relevant to quantify the additive effects of these chemicals. This process is illustrated in Table 10.

The SLHQs and SLHIs are presented in Table 10. For the future commercial/industrial worker scenario, the SLHI for direct contact with surficial material (and $SLHI_{total}$) is 5.4; both chromium and mercury contribute to this SLHI. Based on an analysis of endpoints, the total lung SLHI is 4.9 (chromium in surficial SWMU material), and the total nervous system SLHI is 1.2 (mercury in surficial SWMU material).

3.4.2 Carcinogenic Risk

In a human health risk assessment, carcinogenic health risks are defined in terms of the probability of an individual developing cancer over a lifetime as the result of exposure to a given chemical at a given concentration (USEPA 1989). The incremental probability of developing cancer over a lifetime (*i.e.*, the theoretical excess lifetime cancer risk) is the additional risk above and beyond the cancer risk an individual would face in the absence of the exposures characterized in this risk assessment. In this Tier 1 HHRA, cancer risk was evaluated according to the following equation:

$$SLCR = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}} \; x \; \text{Target Risk Level}$$

Cancer risks are summed regardless of the differences in target organ, weight-of-evidence for human carcinogenicity, or potential chemical interactions (*e.g.*, antagonistic or synergistic effects). This approach is consistent with USEPA's current approach to carcinogenic effects, which is to assume effects are additive unless adequate information to the contrary is available (USEPA 1989). Based on USEPA methodology (USEPA 1989) and as discussed in the Work Plan, if the total screening level cancer risk ($SLCR_{total}$) for each receptor/pathway is less than 1 x 10^{-4}, the risks are considered to be negligible.

The SLCRs for both worker scenarios are below 1 x 10^{-4}. The $SLCR_{total}$ for the future commercial/industrial worker scenario is 2 x 10^{-5}, attributable to direct contact with benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene in surficial SWMU material. The $SLCR_{total}$ for the future construction worker scenario is 1 x 10^{-6}, attributable to direct contact with benzo(a)pyrene in surface or subsurface SWMU material.

3.4.3 Conclusions

The results of the Tier 1 HHRA are that levels of mercury and chromium in surface SWMU material are greater than noncarcinogenic RBSLs for the future commercial/industrial worker. For these scenarios, therefore, the calculated hazard indices are greater than the Tier 1 noncarcinogenic benchmark of 1.0. Based on these results and in accordance with the work plan, further evaluation will be completed during the Corrective Measures Study (CMS) and may include a Tier 2 assessment or an evaluation of corrective measures. The uncertainties inherent in these conclusions are presented in the following Uncertainty Analysis.

3.5 Uncertainty Analysis

There are multiple sources of uncertainty that may be identified for any risk assessment. These include, among others, uncertainty associated with the toxicity criteria used to derive dose-response factors, uncertainties associated with exposure parameters used in the exposure assessment, and uncertainties associated with combining exposure parameters and toxicity criteria to characterize risk.

In the development of any health assessment, some level of uncertainty is introduced each time an assumption is relied upon to describe a dynamic parameter. Some assumptions have a significant scientific basis while others do not, which may result in the selection and use of conservative, default exposure parameters in the exposure assessment. The selection of multiple conservative assumptions in the exposure assessment generally results in an overestimation of potential health risks associated with exposure to specific chemical constituents. The primary areas of uncertainty for this risk assessment are qualitatively discussed below.

3.5.1 Site Sampling and Representative Concentrations

It should also be noted that for all COPCs in subsurface SWMU material, the maximum concentration was used as the representative concentration in this HHRA. This was because an insufficient number of samples were collected to calculate a 95% UCL. A closer look at the concentration of chromium indicates that the maximum (*i.e.*, representative concentration) is an estimated value that is much higher than the other concentrations of chromium that detected for this SWMU. Additionally, it was conservatively assumed that this maximum estimated concentration was hexavalent chromium, the more toxic form of chromium. The representative concentrations were used to compare to the RBSLs calculated for this HHRA, and ultimately determine the chemicals of interest in this HHRA. Use of the maximum concentrations of the biased sampling is a very conservative methodology utilized in this HHRA.

3.5.2 COPC Selection Process

The COPCs evaluated for this SWMU were identified in the HHRA ID No. 1 (BSC 1998). These chemicals were selected in part because of their representative concentrations exceeded Region III RBCs (USEPA 2000b) for residential scenarios. Since no residential exposures are realistic for any of the on-site scenarios, some chemicals have been retained as COPCs that are not likely to pose a potential threat to most of the human receptors evaluated here.

3.5.3 Use of Subsurface Data to Represent Surface Data

As mentioned previously, surface data were not collected for this SWMU; therefore, subsurface data were used as surrogate data for surface material. Based on previous activities at this SWMU, it was assumed that the SWMU material in SWMU S-17 is homogeneous, and that the COPCs are the same in both horizons. Based on previous SWMU activities, which demonstrated distinct layers of material, the possibility does exist that the constituents in subsurface SWMU material may not be the exactly same as those in surface SWMU material (i.e., the concentrations of COPCs could be more or less in surface soil than in subsurface soil). In the case of volatile organic compounds, those found in surface soil would likely dissipate rapidly if exposed to the atmosphere (*i.e.*, the representative concentrations would be much lower than those used here). However, surficial concentrations of metals or semivolatile organics could be either over- or underestimated.

3.5.4 Exposure Parameters

Several conservative default exposure parameters (*e.g.*, inhalation rates, exposure frequency, exposure duration) were incorporated into the exposure assessment to define general population behavior. For example, for the industrial/commercial worker scenarios, default exposure parameters are intended to be conservative and representative of an individual who is consistently present at the site 24 hours a day, 250 days a year, in the area of highest concentration. It is more likely that the exposure of an industrial worker to a *particular SWMU* (i.e., SWMU material) on the Lackawanna site is limited to an average of only a few hours a day, 2 weeks year. Most parameters incorporated into the exposure assessment to define the receptor scenarios are conservative values and used to define a worst-case population behavior. The net effect of using multiple conservative exposure assumptions is the overestimation of potential health risks.

Additionally, for a receptor population such as an industrial worker or a resident (*i.e.* where exposure duration is greater than 250 days/year), exposure frequency typically is corrected in site-specific health risk assessments for the fraction of the year when outdoor exposure to soil are limited due to severe weather conditions such as snow, ice, rain and freezing temperatures (USEPA 1989). This factor is called a meteorological factor. Because of the geographical location of the Lackawanna site, a correction factor for weather conditions would be reasonable. In this Tier 1 HHRA, exposure did not exclude days when the temperature is less than 32°F, when there is snow cover, or the ground was wet from other forms of precipitation. Applying a more realistic exposure frequency and a meteorological factor would result in higher RBSLs.

3.5.5 Toxicity Assessment

Noncarcinogenic Criteria- Toxicity information for many of the COPCs is limited for humans. Consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty will be associated with the calculated toxicity values. The USEPA derives reference concentrations (inhalation exposures) and reference doses (oral exposures) for chemicals using an uncertainty factor (UF) approach. The UF for arsenic, for instance, is 3. This was applied to account for both the lack of data to preclude reproductive toxicity as a critical effect and to account for some uncertainty in whether the NOAEL of the critical study accounts for all sensitive individual. The UF for chromium, however, is 300. The uncertainty factor of 300 represents two 10-fold decreases in dose to account for both the expected interhuman and interspecies variability in the toxicity of the chemical in lieu of specific data, and an additional factor of 3 to compensate for the less-than-lifetime exposure duration of the principal study.

Carcinogenic Criteria- USEPA cancer SFs are developed using variations of the Linear Multistage Model (LMS) for carcinogenicity. The LMS is highly conservative as it assumes linearity between dose and effect to zero dose, assuming no threshold for carcinogenicity. However, the human body has mechanisms to detoxify most chemicals particularly at low doses, and therefore many scientists believe that most, if not all carcinogens only cause cancer above a "threshold dose."

The carcinogenic COPCs for this SWMU include arsenic. The inhalation slope factor for arsenic is based on human data from occupational exposure studies, and thus an extrapolation from animal data is not necessary, thereby reducing the some uncertainty in the slope factor. However, there is significant uncertainty associated with the low-dose extrapolation (environmental exposures are relevant in the low-dose range) used to generate the slope factor. The USEPA has used its default linear model to estimate risks in the low-dose range citing lack of carcinogenic mode of action information. Thus, should this information become available, the low-dose carcinogenic risks for arsenic may be evaluated differently.

Additionally, the derivation of the slope factor for benzo(a)pyrene has some uncertainty. The oral SF for benzo(a)pyrene (7.3 $(mg/kg\text{-}day)^{-1}$) is the geometric mean of four slope factors derived from two rodent feeding studies: Neal and Rigdon (1967), a mouse study and Brune et al. (1981), a rat study. Three of the four values employ the data from the Neal and Rigdon (1967) study. The fourth cancer slope factor estimate was made using the linearized multistage model to calculate the upper 95% confidence interval on the slope in the low-dose region using the data of Brune et al. (1981). The Neal and Rigdon (1967) study suffers from several study design flaws including dosing regimens and length of observation periods. Thus, in three of its four cancer slope factor estimates, USEPA mathematically manipulated data from a poor animal bioassay that did not conform to the standards of modern toxicology to derive the values. Additionally, the mouse cancer slope factor was translated into a human cancer slope factor but there are no studies showing that ingestion of PAHs can cause cancer in humans.

Absence of Inhalation Toxicity Criteria - Although toxicity information is generally available for the most significant chemicals and exposure routes in this HHRA, there are some volatile COPCs in this HHRA for which no inhalation toxicity criteria (RfDs or cancer slope factors) exist. In the absence of data, either the oral RfD or oral SF was used to evaluate inhalation exposures. This methodology assumes that the chemicals are equitoxic by both routes. The letter "R" on Table 6 notes these instances. It is more conservative to evaluate these chemicals for inhalation exposures than to not evaluate them at all. Thus, this method potentially overestimates inhalation risks for COPCs evaluated as such. This uncertainty is not applicable, however, to the inhalation RfCs or slope factors for the COPCs, which showed exceedances of their Tier 1 RBSLs at this SWMU.

3.5.6 Risk Characterization

Uncertainties in the risk characterization portion of the risk assessment for the site are a combination of the uncertainties associated with both the dose-response assessment and the exposure assessment. As discussed above, the assumptions and parameters used for both the dose response and exposure assessments are extremely conservative. In addition, since the toxicity criteria and exposure parameters are combined in the risk characterization, the conservatism is compounded.

3.5.7 Uncertainty Analysis Summary

This Tier 1 HHRA includes uncertainties and conservative assumptions that, in general, effectively combine to overestimate the potential current and future exposures. The major sources of uncertainty contributing to the conservatisms in this HHRA are summarized below:

- Use of maximum concentrations as representative concentrations
- Compounding effect of multiple conservative exposure parameters
- No meteorological factor assumption
- Confidence in toxicity criteria

The net effect of the uncertainties of this HHRA is the generation of risk and hazard estimates that probably far exceed any true exposure conditions that currently exist or which could possibly exist in the future.

4.0 CONTAINMENT

The waste stored at SWMU was placed into two parallel trenches excavated in the slag fill. The site is uncovered. There are no engineered landfill structures such as covers or liners present. A site inspection in September 1996 by Dames & Moore found no evidence of surface water runoff from the trenches. The trenches within SWMU S-17 do collect some surface water run-on. The collected water either evaporates or infiltrates the surface. Precipitation that runs-off of the SWMU remains confined to the area immediately surrounding the SWMU because of the flat topography of the area. The runoff infiltrates into the ground or evaporates.

5.0 CONCLUSIONS

Based on review of the data, the following conclusions can be made:

- The TCLP extract concentrations indicate that the materials in SWMU S-17 do not meet TCLP criteria.

- SPLP analysis indicates that the materials in SWMU S-17 are not likely to be leaching at significant concentrations.

- Total constituent analysis shows that several VOCs, SVOCs and metals are present within the SWMU material.

- The results of the Tier 1 HHRA are that levels of mercury and chromium in SWMU material are greater than noncarcinogenic RBSLs for the future commercial/industrial worker. For these scenarios, therefore, the calculated hazard indices are greater than the Tier 1 noncarcinogenic benchmark of 1.0. Cancer risks for all populations are considered negligible since they are below 1×10^{-4}.

Based on these results and in accordance with the work plan, further evaluation will be completed during the Corrective Measures Study (CMS) and may include a Tier 2 assessment or an evaluation of corrective measures.

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SWMU ASSESSMENT REPORT
LIME DUST AND KISH LANDFILL R
(SWMU S-18)

BETHLEHEM STEEL CORPORATION
LACKAWANNA, NEW YORK

SEPTEMBER 2004

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ATTACHMENTS

Attachment 1 USEPA Comments to SWMU S-18 Preliminary SWMU Report

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1.0 INTRODUCTION

This report documents the results of an environmental assessment of Lime Dust and Kish Landfill R at Bethlehem Steel Corporation's (BSC's) Lackawanna, New York facility. The Lime Dust and Kish Landfill R was identified as Solid Waste Management Unit (SWMU) S-18 in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) for the facility (USEPA 1988). Landfill R was designated as a SWMU because it received two waste products of the basic oxygen furnace process—lime dust (calcium oxide) and kish (consisting principally of carbon fines) (USEPA 1988). The United States Environmental Protection Agency (USEPA) has required that a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of this and other SWMUs at the BSC facility be completed in accordance with the Administrative Order on Consent (AOC) signed by BSC and USEPA in 1990 (USEPA 1990). The RFI has been conducted in phases (Phases I, IIA, IIB, IIC, and III), and included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. This report evaluates data available to BSC as of November 2001.

An initial SWMU assessment was completed in 1992. The USEPA reviewed and commented on the SWMU S-18 assessment in 1993. This SWMU S-18 assessment includes information to further clarify issues noted in the USEPA comments. A copy of the USEPA comments is provided in Attachment 1.

1.1 Description

SWMU S-18 is an approximately 2-acre, irregularly shaped area located in the northwest portion of Zone 4 of the Slag Fill Area (Figure 1). There are approximately 40 exposed piles of disposed lime dust and kish placed on the slag fill surface with an approximate total volume of 600 cubic yards. The piles, which are located on the northwestern and north ends of the SWMU boundary, are not covered and are exposed to wind and rain. Additionally, in the central portion of the SWMU there is a sloped mound of lime, kish, and slag fill that is approximately 150 feet long and 75 feet wide, with a height ranging from 1 to 9 feet. The extent of the mound material below the surrounding grade is unknown. The volume of this pile, however, is estimated to be 1,900 cubic yards.

The piles are on and surrounded by slag fill at an approximate elevation of 620 feet above mean sea level (msl). Groundwater is at an approximate elevation of 570 feet above msl. Surface water runoff is generally contained within the SWMU S-18 area, although some surface water runoff can occur on the southeastern and northern perimeters of the SWMU.

1.2 History

From 1966 to 1983, two waste products of the basic oxygen furnace (BOF) process, lime dust (calcium oxide) and kish (consisting principally of carbon fines), were disposed of in this landfill. Lime dust, or burnt lime, was produced through the unsuccessful dehydration of lime (i.e., it was either baked too long or not long enough), making it unsuitable for steel making operations. During the hydration process, the lime contacted no other process operations where it could have been intermixed with other waste streams. Kish consists primarily of carbon fines and iron oxides. During handling, the hot iron metals from the Blast Furnace cools down and the carbon that saturates the hot iron separates from solution in the form of a fine particulate. Kish was collected in baghouses at the reladling stations in the BOF where the hot metal was poured in to ladles to be charged into the BOF vessels to make steel. Kish was collected from the baghouses and disposed. Deposition of lime and kish disposal ceased in 1983 when steel making operations shut down. Neither lime dust nor kish are suspected to contain hazardous constituents (USEPA 1988).

On February 20, 1996, BSC filed a declaration in the Erie County Clerk's Office limiting future use of the property around and including SWMU S-18. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevented the installation and operation of extraction or water wells for the purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants, and Restrictions is provided in Attachment 2.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (US Army Corp) show that the dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the current slag fill area (SFA), including the area immediately under SWMU S-18. The contribution of this particular SWMU to groundwater contamination is not known. The potential impact to groundwater beneath the site, especially in the sand unit in the groundwater Zone 3, 4, and 5 is further assessed in the RFI.

The condition of SWMU S-18 has been monitored since June 1992, when BSC reportedly conducted a site inspection that consisted of a walk-through visual inspection. Dames & Moore visited the site in September 1996. URS inspected the SWMU on June 4, 2000. During all three visits, conditions at the unit were found to be consistent with the descriptions in Section 1.1 and Section 4.0 of this report. Documentation of the 1996 and 2000 site visits are provided in Appendix A. Written documentation of the 1992 BSC inspection was not available.

2.0 SAMPLING AND ANALYSIS

Waste and groundwater sampling was conducted in and near SWMU S-18 between 1991 and 2000. Samples of the waste were collected in 1992 for waste characterization as part of the RFI Phase 1 investigation. Samples were also collected in 1994 and 2000 as part of subsequent phases of the RFI. All waste sampling was conducted in accordance with USEPA approved Work Plans (BSC 1989, revised 1990, 1993, 1994, 1997, 1999a).

Groundwater near SWMU S-18 was sampled over several phases of the RFI starting in 1991 and concluding in 2000. All groundwater sampling was conducted in accordance with USEPA approved work plans (BSC 1989, revised 1990, 1993, 1994, 1997, 1999a). A complete list of the site-specific compounds targeted for groundwater analysis in the site investigations is provided in Table 1. Laboratory analytical reports are provided in Section II of the RFI.

There are two groundwater units beneath the site: the shallow fill unit and the deeper sand unit. The shallow fill unit wells are labeled as "A" wells, while the deeper sand unit wells are typically labeled as "B" wells. Groundwater contour maps for the fill and sand units are presented in Figures 2 and 3, respectively.

2.1 Waste Characterization

On June 17, 1992, a composite sample was obtained from discrete surface grab samples collected at several randomly selected piles of lime and kish exposed at the surface. The sample was analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for seven heavy metals (arsenic, cadmium, chromium, lead, nickel, selenium, and thallium).

On June 15, 1994, two discrete surface grab samples were collected. One sample was collected from a pile of exposed lime dust (S18-LIME) and one from a pile of exposed kish (S18-KISH) (Figure 1). Samples were collected from the 0- to 6-inch depth interval and were analyzed for total volatile organic compounds (VOCs), total semivolatile organic compounds (SVOCs), and metals.

On October 25, and 26, 2000, two borings were advanced in the lime and kish pile area. One kish sample (S-18-B1 (2-4) Kish) was collected from Boring S18-B01. One kish sample (S18-B2 (2-4) Kish) and one lime sample (S18-B2 (2-4) Lime) was collected from Boring S18-B02. All three samples were analyzed for total VOCs, SVOCs and metals. Laboratory analysis included TCLP, Synthetic Precipitation Leaching Procedure (SPLP) and total constituent analysis. Total cyanide, chloride, total recoverable phenolics and sulfates were also analyzed.

On October 26, 2000, two kish grab samples (S18-Kish-Grab1 and S18-Kish-Grab2) were collected from two representative kish piles and two lime grab samples (S18-Lime-Grab1 and S18-Lime-Grab2) were collected from two representative lime piles. Samples were analyzed for total VOCs, SVOCs and metals. Laboratory analysis included TCLP, SPLP and total constituent analysis. Total cyanide, chloride, total recoverable phenolics and sulfates were also analyzed.

On October 26, 2000, two composite kish samples (S18-Kish-Comp1 and S18-Kish-Comp2) were collected from 9 kish piles and two composite lime samples (S18-Lime-Comp1 and S18-Lime-Comp2) were collected from 26 lime piles. Samples were analyzed for total VOCs, SVOCs and metals. Laboratory analysis included TCLP, SPLP and total constituent analysis. Total cyanide, chloride, total recoverable phenolics and sulfates were also analyzed.

A summary of the detected analytes for the 1994 and 2000 sampling events is provided in Table 2 and Table 3. Field sampling records are provided in Appendix B. Laboratory results for samples collected in 1992 are provided in Appendix C.

2.1.1 1992 TCLP Results

TCLP results were compared to regulatory concentration levels listed in 40 CFR Part 261. TCLP results show that all of the metals analyzed for (arsenic, barium, cadmium, chromium, lead, selenium and silver) were below detection limits and, therefore, did not meet TCLP criteria.

2.1.2 1994 Total Constituent Results

For the kish sample (S18-KISH), VOCs were not present above detection limits. Only trace levels of four polynuclear aromatic hydrocarbons (PAHs) ranging from fluoranthene [84.0 micrograms per kilogram (μg/kg)] to benzo(g,h,i)perylene (110 μg/kg) were detected at levels below the reporting limits. The PAHs are typical of coal combustion by-products. Eight metals were detected above method detection limits in the kish sample, ranging from thallium [7.1 milligrams per kilogram (mg/kg)] to lead (452 mg/kg).

In the lime dust sample (S18-Lime), no VOCs or SVOCs were present above detection limits. Only four metals were present above detection limits ranging in concentration from 2.8 mg/kg of selenium to 87.5 mg/kg of antimony and lead, respectively.

2.1.3 2000 Total Constituent Results

Lime and kish samples from borings S18-B01 and S18-B02 had 11 detected SVOCs and 14 detected metals. No VOCs were detected in the samples. SVOCs were found in higher concentrations in the Kish samples. SVOC concentrations ranged from 48 μg/kg of pyrene [S18-B02 (3-4 ft) LIME] to 60,000 μg/kg of fluoranthene [S18-B01 (2-4 ft) KISH]. Metals ranged in concentration from 0.1 mg/kg of mercury [S18-B01 (2-4 ft) KISH] to 323,000 mg/kg of calcium [S-18-B02 (2-4 ft) LIME].

Analytical results for the kish grab and composite surface samples showed the presence of several SVOCs and metals. The seven SVOCs detected ranged from 260 μg/kg of phenanthrene in S18-KISH-G01 to 3,800 μg/kg of chrysene in S18-KISH-G02. Fourteen metals were detected in samples. Concentrations ranged from 0.43 mg/kg of mercury to 99,200 mg/kg of calcium, both in S18-KISH-G01. VOCs were not detected in the grab samples. VOCs were not analyzed in the composite samples.

Results for the grab and composite lime surface samples showed no VOCs detected in the grab sample and no SVOCs detected in the grab and composite samples. VOCs were not analyzed in the composite sample. Up to twelve metals were detected in the four samples analyzed. Concentrations ranged from 0.018 mg/kg of mercury in S18-LIME-CO2 to 533,000 mg/kg of calcium in S18-LIME-C02. The second and third highest metal concentrations were magnesium (57,200 mg/kg) and lead (216 mg/kg), both present in S18-LIME-G01.

2.1.4 2000 SPLP Results

SPLP analysis was conducted to more closely mimic the effect of compounds leaching from the waste piles due to rainwater infiltration. The analysis was performed in accordance with the USEPA's SW846 Method 1312 protocols. The SPLP results help evaluate what compounds can potentially leach from the waste piles into the subsurface. Several VOCs, SVOCs and metals, all at low concentrations, were detected in the kish and lime samples from borings S18-B01 and S18-B02. Although no VOCs were detected in the Total Constituent analysis, 4 VOC compounds were detected, with concentrations ranging from .0021 milligrams per liter (mg/L) of ethylbenzene to 0.011 mg/L of toluene, both detected in S18-B02 (2-4 ft) LIME. Three SVOCs were detected, ranging from .0041 mg/L of naphthalene in S18-B02 (2-4 ft) LIME to 0.013 mg/L of both naphthalene and phenanthrene in samples S18-B02-(2-4 ft) LIME and S18-B01 (2-4 ft) KISH, respectively. SPLP results for the kish and lime grab and composite surface samples showed no VOCs present, and only one SVOC [bis(2-ethylhexyl)phthalate at .004 mg/L] detected in one of the kish grab surface samples (S28-KISH-G02).

Eleven metals were also detected at low concentrations in both boring and surficial samples. The detections ranged from 0.000047 mg/L of mercury in samples S18-B2 (2-4 ft) KISH to 948 mg/L of calcium in S18-LIME-C01. The next two highest metals detected were potassium (710 mg/L) and magnesium (57.5 mg/L), both present in S18-KISH-G01.

2.1.5 2000 TCLP Results

TCLP results for the kish samples from Borings S18-B01 and S18-B02 showed no VOCs, several SVOCs and several metals present. All of the detected parameters were at low concentrations. Laboratory results for the lime sample from Boring S18-B02 revealed three VOCs, one SVOC and several metals at low concentrations.

TCLP results for the surficial kish and lime grab and composite samples showed the presence of several VOCs, SVOCs, and metals in most of the samples. Concentrations were generally low. Lead results, however, ranged from 15.4 mg/L to 37.7 mg/L, which indicates that the concentration of lead in the TCLP extract on the surface kish material in SWMU S-18 does meet TCLP criteria.

2.2 Groundwater

Six monitoring wells, MWN-05A, MWN-05B, MWN-05D, MWN-14A, MWN-14B, and MWN-42A were used to evaluate the groundwater near SWMU S-18. Monitoring wells MWN-05A, MWN-14A, and MWN-42A are screened in the fill unit. Monitoring well MWN-05D is screened in the bedrock. MWN-05B and MWN-14B are screened in the sand unit. Monitoring well locations are shown in Figures 1, 2, and 3. Groundwater elevation contours for the fill and sand units are shown in Figure 2 and Figure 3, respectively.

On October 25, 2000, monitoring well MWN-42A was installed approximately 500 feet east and upgradient of SWMU-S18. Additionally, monitoring wells MWN-14A and MWN-14B are situated approximately 1,000 feet upgradient of SWMU S-18 (Figures 2 and 3). Monitoring wells MWN-05A, MWN-05B, and MWN-05D are located downgradient of SWMU S-18.

From 1991 to 1999, several rounds of groundwater samples were collected from upgradient wells MWN-14A and MWN-14B and downgradient wells MWN-05A, MWN-05B, and MWN-05D over several phases of the RFI. In November 1999, all of the onsite wells were sampled within nine days. However, monitoring well MWN-42A has been sampled only once, on December 19, 2000, following its installation. Analytical data from the 1999 and 2000 sampling events are used to evaluate groundwater conditions relative to SWMU S-18. A summary of detected analytes in the downgradient wells and upgradient wells is presented in Table 4A and Table 4B, respectively.

2.2.1 Groundwater Results

For the groundwater samples collected in 1999 and 2000, several VOCs, SVOCs, and metals were detected in the three upgradient wells (MWN-14A, MWN-14B and MWN-42A) and in the three downgradient wells (MWN-05A, MWN-05B and MWN-05D). For the shallow ("A") wells placed in the fill, concentrations of these parameters were generally higher in the upgradient wells.

In the sand unit, monitoring well MWN-05B, contained concentrations of 2 VOCs (chlorobenzene and ethylbenzene), SVOCs (acenaphthylene, anthracene, bis(2-ethylhexyl)phthalate, 3&4-methylphenol, naphthalene, and phenol) and total metals (barium, cadmium, calcium, chromium, iron, lead, magnesium, nickel, potassium, silver, and sodium) that were of slightly higher concentrations than in the upgradient well MWN-14B, which is screened in the same geologic unit. USACE dredge spoils are present within this unit; therefore it is unknown what effect these materials have had on groundwater quality.

In bedrock well MW-05D, one VOC (xylene), no SVOCs and 8 metals (barium, calcium, chromium, iron, magnesium, nickel, potassium and sodium) were detected at concentrations lower than those found in the upgradient and downgradient wells located in the overlying groundwater zones.

2.3 Summary of Analytical Data

Total analysis of the subsurface material indicated that 11 SVOCs and 14 metals were present. The surface kish material contained 7 SVOCs and 14 metals in detectable concentrations. The surface lime material contained no VOCs or SVOCs, but did contain 12 metals.

SPLP analysis indicated that 11 of the 12 metals detected in the total-analysis samples have the potential to leach from the surface materials. SPLP results for the kish and lime grab and composite surface samples showed no VOCs present, and only one SVOC [bis(2-ethylhexyl)phthalate at .004 mg/L] detected in one of the kish grab surface samples (S28-KISH-G02).

The concentration of lead in the TCLP extract of the surficial kish material in SWMU S-18 does meet TCLP criteria. However, for those samples that were above RCRA criteria for lead, the corresponding SPLP analyses for the same samples were non-detect. Lime was determined to be nonhazardous.

Total metal concentrations in the upgradient and downgradient wells indicated that several SVOCs and numerous metals present in the SWMU material were also present in the downgradient wells at concentrations higher than upgradient wells. USACE dredge spoils are present in the sand unit, and it is unknown what effect these materials have had on groundwater quality. Further evaluation of the potential groundwater impacts resulting from the dredge spoils is provided in the RFI.

The presence of a restrictive covenant on the slag fill area, including SWMU S-18, restricts the current and future use of the property to commercial and industrial uses. In addition, groundwater use is also restricted. This reduces the risk of exposure to the SWMU material.

The potential risks associated with the compounds detected in the SWMU material are further evaluated in the Human Health Risk Assessment presented in Section 3.0.

3.0 RISK ASSESSMENT

A human health risk assessment, as described in the *Human Health Risk Assessment* Work Plan (BSC 1997), was conducted for SWMU S-18. The results of the Tier 1 Human Health Risk Assessment (HHRA) are presented here and are organized into the following sections: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization and Uncertainty Analysis. The major components of this HHRA have previously been presented in Human Health Risk Assessment Report, Part IV of this RFI Report. Therefore, the following sections provide summary overviews of previously presented information. This section, therefore, serves as a summary report, bringing together all associated and related work from previous risk assessment deliverables, and providing the conclusions of the SWMU-specific risk assessment.

3.1 Data Evaluation

A list of 96 constituents of potential interest (COPIs) was developed for the BSC Lackawanna, New York facility based on USEPA and industry studies (BSC 1998). The list contains hazardous constituents that could be present in the waste streams as a result of integrated iron and steel plant operations, such as those historically conducted at the Lackawanna site. The Human Health Risk Assessment ID No. 1 (BSC 1998) established the chemicals of potential concern (COPCs) for each SWMU at the Lackawanna Site. The COPCs were determined by sequentially applying the following criteria to each COPI on a medium by medium basis for each SWMU and watercourse: 1) the chemical was detected in at least 5% of the samples, 2) the chemical was detected in at least one sample at levels above background (*i.e.*, the maximum concentration was above background; for chemicals in surficial SWMU material only), and 3) the chemical was positively detected in at least one sample at levels above applicable screening criteria [*i.e.*, the maximum concentration was greater than the screening criteria: USEPA Region III Risk Based Concentrations (RBCs), USEPA Soil Screening Levels (SSLs), or NYSDEC Ambient Water Quality Standards and Guidance values]. In accordance with ID No. 1, a background comparison was not made for the subsurface SWMU material in this report.

The sampling data for SWMU S-18 (as presented in Section 2.0 of this report) were evaluated in order to identify the site-related COPCs for the SWMU. COPCs were originally determined in ID

No. 1, however, as some screening criteria were revised since ID No. 1 was submitted, the screening process was also updated and is presented in Tables 5 and 6. For the groundwater evaluation, data from groundwater Zone 4 was used. Based on the above criteria, and ID No. 1, twenty COPCs were identified for SWMU S-18. Five inorganic (antimony, arsenic, chromium, lead, thallium) and no organic chemicals were identified in surficial SWMU material (Table 5). Four inorganic (arsenic, chromium, lead, thallium) and three organic (anthracene, benzo(a)anthracene, benz(a)anthracene) COPCs were identified in subsurface soil (Table 6). Fourteen organic (benzene, chlorobenzene, 1,1-dichloroethane, ethylbenzene, methylene chloride, pyridine, toluene, trichloroethene, xylenes, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene) COPCs were identified in groundwater (Table 7).

Representative concentrations were then determined for each COPC. If the sample size for a dataset was ten or greater, the 95% upper confidence limit of the mean was used. For those datasets with sample sizes of less than ten, the maximum concentration was used. Ten samples were collected of the surficial SWMU material, therefore, 95% UCL could be calculated. Three samples were collected of subsurface SWMU material; therefore, the maximum concentration was used to represent these COPCs. SWMU S-18 is located in Groundwater Zone 4 (BSC 1998), which had more than ten samples; therefore, the 95% UCL was used. The COPCs, as determined in ID No. 1, and their representative concentrations are presented in Table 8.

3.2 Exposure Assessment

The exposure assessment conducted for SWMU S-18 included a review of current and future human receptor scenarios and potential exposure pathways, as related to COPCs. In general, exposure pathways by which a human receptor could come into contact with SWMU material are defined by four components (USEPA 1989):

- A source and mechanism of constituent release to the environment;
- An environmental transport mechanism;
- A point of potential human contact with the affected medium, and
- A route of entry into humans.

If any one of these components is missing, the pathway is considered incomplete and does not contribute to receptor exposure.

Human Health Risk Assessment ID No. 2 (BSC 1999) presented the current and future human receptor scenarios and potentially complete exposure pathways for each of the SWMUs identified at the Lackawanna Site. For SWMU S-18, the potential receptor scenarios include a current non-BSC commercial/industrial worker, a future commercial/industrial worker, a future construction worker, a future utility/maintenance worker, a trespasser, a future marina worker, a future greenway user, a future fenceline resident, and a present fenceline resident. Potentially complete exposure pathways were established for each receptor scenario. For the commercial/industrial worker scenario, the utility/maintenance worker scenario, and the trespasser scenario, the following pathways were determined to be complete: direct contact (*i.e.*, ingestion or dermal contact) with surface SWMU material, inhalation of airborne particulates from uncovered surface SWMU material, or from inhalation of vapors from groundwater. These pathways also apply for the construction worker and utility/maintenance worker scenarios; however, these receptors could additionally be exposed to subsurface SWMU material during potential future digging activities. For the marina worker scenario, greenway user scenario, and residential scenarios, inhalation of particulates in surficial SWMU material is the only complete exposure pathway. A detailed description of the potentially exposed receptor scenarios and pathways for SWMU S-18 can be found in ID No. 2 (BSC 1999), and a summary is provided in Table 9.

3.3 Toxicity Assessment

A toxicity assessment characterizes the relationship between the exposure to a COPC and the frequency of adverse health effects that may result from such an exposure (dose-response). The end result of the dose-response assessment is the determination of human uptake levels that provide an adequate measure of protection to exposed persons for carcinogenic and noncarcinogenic endpoints. The derivation of acceptable levels of exposure (*e.g.*, risk-based screening levels (RBSLs)) and the manner in which these levels are used in this HHRA are discussed below.

Tier 1 RBSLs were calculated and compared to the representative SWMU-18 COPC concentrations. Risk-based screening levels are defined as concentrations of COPCs in media that are not expected to produce any adverse health effects under chronic exposure conditions. Tier 1 RBSLs were developed using information previously defined and described in detail in the Work Plan and ID No. 2; this information is summarized here. The equations used to calculate the RBSLs follow basic USEPA risk assessment principles (USEPA 1989; 1996). Conservative exposure parameters, as defined by the ASTM Standard (ASTM 1995) and USEPA guidance (USEPA 1989; 1991a, and 1991b), and USEPA toxicity criteria (USEPA 2001); were inputs into these equations to develop the RBSLs. As some of the toxicity criteria have been updated by the USEPA since originally presented in ID No. 1, they are presented in Table 10 of this HHRA. The above information was used to calculate Tier 1 RBSLs for COPCs in SWMU material and groundwater, for each of the nine exposure scenarios.

It should be noted that, in groundwater, many of the RBSLs calculated were greater than the chemical's solubility in water. This indicates that, based on the predicted amount of chemical volatilization, pure product in the groundwater would not pose an inhalation health threat from these chemicals. The solubility limits of these chemicals are indicated in Table 11.

Similarly, the RBSL calculated for anthracene in subsurface SWMU material (trespasser scenario) was determined to be health protective at a concentration that is greater than its saturation limit in soil. It is important to consider that chemical emissions from soil to air reach a plateau at the chemical's saturation limit, and volatile emissions will not increase above this level, regardless of how much more chemical is added to the soil. In other words, the exposure concentration for an inhalation-only scenario cannot exceed a chemical's soil saturation limit. Furthermore, an RBSL that is above the saturation limit is not likely to pose an increased risk or hazard (USEPA 1996a). Therefore, this RBSL for anthracene, which is based only upon the inhalation pathway, is capped at the saturation limit, and "> sat" is indicated on Table 11. Other RBSLs that are not based solely on inhalation were not capped at the saturation limit, as the potential exposure concentrations are greater than the saturation limit for direct contact scenarios (e.g., dermal contact, ingestion).

Lastly, some of the RBSLs for COPCs in SWMU material were determined to be health protective at levels that are greater than 1,000,000 parts per million (mg/kg); such cases are noted by the following indicator ">1,000,000" in Table 11. For those RBSLs that were based on inhalation, if a calculated RBSL is greater than both the saturation limit in soil and 1,000,000 mg/kg, ">1,000,000" is shown in Table 11 as it is more indicative of the level of health-protectiveness.

In accordance with ID No. 2, lead in SWMU material was evaluated for the industrial/commercial, construction worker, utility/maintenance and trespasser direct contact scenarios; it was not evaluated for any other scenario (i.e., inhalation routes).

In accordance with Part IV of this RFI report, those COPCs that do not exceed the Tier 1 RBSLs are not evaluated further. For those COPCs that exceed Tier 1 RBSLs, the risk to human health is evaluated further in the Tier 1 Risk Characterization.

A comparison of the representative COPC concentrations to RBSLs for each of the exposure scenarios is presented in Table 11. This comparison provides a preliminary screening of potential risk to the specific receptor populations and exposure pathways identified for this SWMU. As presented in Table 11, the following chemicals exceeded the future commercial/industrial worker scenario RBSL for direct contact with surficial SWMU material: antimony, arsenic, lead and thallium. For the future construction worker scenario, antimony, arsenic, lead and thallium also exceed the direct contact with surficial SWMU material RBSLs, and arsenic, lead and benzo(a)pyrene exceeded the direct contact with subsurface SWMU material RBSLs. Lead exceeds the direct contact with surficial SWMU material RBSL for the future utility/maintenance worker scenario, and lead and benzo(a)pyrene exceed the direct contact with subsurface material RBSL for this scenario. For the trespasser, the representative concentration of lead in surface soil exceeds the direct contact RBSL. For all other scenarios and chemicals, the representative concentrations are below the respective RBSLs and therefore, are not evaluated further.

3.4 <u>Risk Characterization</u>

Risk characterization involves the estimation of the magnitude of potential adverse health effects of the COPCs, and summarizing the nature of the health impact to the defined receptor populations. It combines the results of the toxicity and exposure assessments to provide numerical estimates of health risk.

In accordance with Part IV of this RFI report, those COPCs that exceed an RBSL were further evaluated in the Tier 1 Risk Characterization, or HHRA. For those COPCs that exceeded an RBSL, a screening-level hazard index (SLHI) was calculated to evaluate noncarcinogenic health effects, and a total screening-level cancer risk ($SLCR_{total}$) was calculated to evaluate carcinogenic effects. SLHI and $SLCR_{total}$ methodology are presented in Part IV (BSC 1998). The Tier 1 HHRA results are presented in Table 12.

3.4.1 Noncarcinogenic Hazard

The noncancer hazards were assessed in this HHRA using a hazard quotient approach (USEPA 1989). For each COPC, the noncarcinogenic RBSL was compared to the COPC's representative concentration to determine the screening level hazard quotient (SLHQ) for that chemical. The equation is as follows:

$$SLHQ = \frac{\text{Representative concentration}_{\text{COPC/medium}}}{\text{RBSL}_{\text{COPC/medium/receptor/pathway}}}$$

The SLHQs for each chemical are summed to create a total Screening Level Hazard Index ($SLHI_{total}$) for each pathway. The smaller the SLHQ/SLHI, the greater the degree of protection for that pathway. Based on USEPA methodology (USEPA 1989) and as discussed in the Work Plan, if the SLHI is less than 1, the risks are considered negligible. Those $SLHI_{total}$s that exceed 1 were further evaluated by developing target organ-specific SLHIs. This process is appropriate as only chemicals affect different biological target endpoints, and it is only relevant to quantify the additive effects of similar chemicals. This process is illustrated in Table 12.

For the future commercial/industrial worker scenario, the $SLHI_{total}$ is 8.0. The liver/blood/hair SLHI is 6.5 (antimony and thallium in surficial SWMU material) and the total skin SLHI is 1.5 (arsenic in surficial SWMU material). For the future construction worker scenario, the total SLHI is 2.5. The liver/blood/hair target organ SLHI is also 2.5 (antimony and thallium in surface SWMU material).

3.4.2 Carcinogenic Risk

In a human health risk assessment, carcinogenic health risks are defined in terms of the probability of an individual developing cancer over a lifetime as the result of exposure to a given chemical at a given concentration (USEPA 1989). The incremental probability of developing cancer over a lifetime (*i.e.*, the theoretical excess lifetime cancer risk) is the additional risk above and beyond the cancer risk an individual would face in the absence of the exposures characterized in this risk assessment. In this HHRA, cancer risk was evaluated according to the following equation:

$$\text{SLCR} = \frac{\text{Representative concentration}_{\text{COPC/medium}}}{\text{RBSL}_{\text{COPC/medium/receptor/pathway}}} \; x \text{ Target Risk Level}$$

Cancer risks are summed regardless of the differences in target organ, weight-of-evidence for human carcinogenicity, or potential chemical interactions (*e.g.*, antagonistic or synergistic effects). This approach is consistent with USEPA's current approach to carcinogenic effects, which is to assume effects are additive unless adequate information to the contrary is available (USEPA 1989).

Based on USEPA methodology (USEPA 1989) and as discussed in the Work Plan (BSC 1997), if the total screening level cancer risk ($SLCR_{total}$) for each receptor/pathway is less than 1×10^{-4}, the risks are considered negligible. All SLCRs are below 1×10^{-4}. For the future commercial/industrial worker, the $SLCR_{total}$ is 6×10^{-6}, attributable solely to direct contact with arsenic in surface SWMU material. For the future construction worker scenario, the $SLCR_{total}$ is 1×10^{-6}. This was further broken down by pathway: the SLCR for direct contact with surficial SWMU material is 3×10^{-6} (arsenic) and the SLCR for direct contact with subsurface soil is 8×10^{-6} (arsenic and benzo(a)pyrene). For the future utility/maintenance worker scenario, the SLCR total is 1×10^{-6}, attributable solely to benzo(a)pyrene in subsurface SWMU material.

3.5 Conclusion

The HHRA completed for SWMU S-18 indicates that carcinogenic risks are negligible, but noncancer hazards are not.

The results of the HHRA indicate that antimony, arsenic, and thallium in surficial SWMU exceed noncarcinogenic RBSLs and produce a hazard index greater than the Tier 1 acceptable noncarcinogenic benchmark of 1.0 for certain scenarios. Specifically, for the future commercial/industrial worker scenario, the calculated noncarcinogenic hazard indices for antimony, arsenic and thallium in surface SWMU material are greater than the Tier 1 noncarcinogenic benchmark. For the future construction worker scenario, the calculated noncarcinogenic hazard for antimony and thallium in surface SWMU material is greater than the Tier 1 noncarcinogenic benchmark.

Additionally, lead in surficial SWMU material is found at a level higher than the Tier 1 RBSLs for the future commercial/industrial worker scenario, the future construction worker scenario, the future utility maintenance worker scenario, and the trespasser scenario. In subsurface SWMU material, the representative concentration of lead exceeds the future construction worker scenario and future utility/maintenance worker scenario RBSLs.

Based on these results and in accordance with the work plan, further evaluation will be completed during the Corrective Measures Study (CMS) and may include a Tier 2 assessment or an evaluation of corrective measures. The uncertainties inherent in these conclusions are presented in the following Uncertainty Analysis.

3.6 Uncertainty Analysis

There are multiple sources of uncertainty identified for any risk assessment. These include, among others, uncertainty associated with the toxicity criteria used to derive dose-response factors, uncertainties associated with exposure parameters used in the exposure assessment, and uncertainties associated with combining exposure parameters and toxicity criteria to characterize risk.

In the development of any health assessment, some level of uncertainty is introduced each time an assumption is relied upon to describe a dynamic parameter. Some assumptions have a significant scientific basis while others do not, which may result in the selection and use of conservative, default exposure parameters in the exposure assessment. The selection of multiple conservative assumptions in the exposure assessment generally results in an overestimation of potential health risks associated with exposure to specific chemical constituents. The primary areas of uncertainty for this risk assessment are qualitatively discussed below.

3.6.1 Site Sampling and Representative Concentrations

SWMU samples were selected in an attempt to identify the highest concentrations of chemicals at the site. Sample biasing was accomplished based on visual observations and photoionization detector readings. Thus, the sampling activities are thought to have characterized the most highly impacted areas of the SWMU, and do not represent an average. This is conservative, as a potential receptor is not expected to remain on, or inhale particulates from, one portion of the SWMU for his or her entire exposure duration. Therefore, it is believed that the maximum concentrations used in this HHRA are likely to represent the true maximum site concentrations.

It should also be noted that, for all of the COPCs in subsurface SWMU material, the maximum concentration was used as the representative concentration in this HHRA. This was because an insufficient number of samples were collected to calculate a 95% UCL. Also, the maximum concentration of antimony in surface SWMU material is an estimated value. Thus, the confidence in risk calculations involving this concentration is somewhat less than for other calculations. Use of the maximum concentrations of the biased sampling is a very conservative methodology utilized in this HHRA.

3.6.2 COPC Selection Process

The COPCs evaluated for SWMU S-18 were identified in the Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC 1998). These chemicals were selected in part because of their representative concentrations exceeded Region III RBCs (USEPA 2000b) for residential scenarios. Since no residential exposures are realistic for any of the on-site scenarios, some chemicals have been retained as COPCs, which are not likely to pose a potential threat to most of the human receptors, evaluated here.

3.6.3 Exposure Parameters

Several conservative default exposure parameters (*e.g.*, inhalation rates, exposure frequency, exposure duration) were incorporated into the exposure assessment to define general population behavior. For example, for the industrial/commercial worker scenarios, default exposure parameters are intended to be conservative and representative of an individual who is consistently present at the site 24 hours a day, 250 days a year, in the area of highest concentration. It is more likely that the exposure of an industrial worker to a *particular SWMU* (i.e., SWMU material) on the Lackawanna site is limited to an average of only a few hours a day, 2 weeks year. Most parameters incorporated into the exposure assessment to define the receptor scenarios are conservative values and used to define a worst-case population behavior. The net effect of using multiple conservative exposure assumptions is the overestimation of potential health risks.

Additionally, for a receptor population such as an industrial worker or a resident (*i.e.* where exposure duration is greater than 250 days/year), exposure frequency typically is corrected in site-specific health risk assessments for the fraction of the year when outdoor exposure to soil is limited due to severe weather conditions such as snow, ice, rain and freezing temperatures (USEPA 1989). This factor is called a meteorological factor. Because of the geographical location of the Lackawanna site, a correction factor for weather conditions would be reasonable. In this Tier 1 human health risk assessment, exposure did not exclude days when the temperature is less than 32°F and when there is snow cover or the ground is wet from other forms of precipitation. Thus, applying a more realistic exposure frequency and a meteorological factor would result in higher RBSLs.

3.6.4 Toxicity Assessment

Noncarcinogenic Criteria- Toxicity information for many of the COPCs is limited for humans. Consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty are associated with the calculated toxicity values. The USEPA derives reference concentrations (RfC; inhalation exposures) and reference doses (oral exposures) for chemicals using an uncertainty factor (UF) approach. The UF for arsenic, for instance, is 3. This was applied to account for both the lack of data to preclude reproductive toxicity as a critical effect and to account for some uncertainty in whether the NOAEL of the critical study accounts for all sensitive individuals.

The UF for chromium, however, is 300. The uncertainty factor of 300 represents two 10-fold decreases in dose to account for both the expected interhuman and interspecies variability in the toxicity of the chemical in lieu of specific data, and an additional factor of 3 to compensate for the less-than-lifetime exposure duration of the principal study.

Carcinogenic Criteria- USEPA cancer SFs are developed using variations of the Linear Multistage Model (LMS) for carcinogenicity. The LMS is highly conservative as it assumes linearity between dose and effect to zero dose assuming no threshold for carcinogenicity. However, the human body has mechanisms to detoxify most chemicals particularly at low doses, and therefore many scientists believe that most, if not all carcinogens only cause cancer above a "threshold dose."

The carcinogenic COPCs evaluated for this SWMU include arsenic. The inhalation slope factor for arsenic is based on human data from occupational exposure studies. An extrapolation from animal data is not necessary, thereby reducing the some uncertainty in the slope factor. However, there is significant uncertainty associated with the low dose extrapolation (environmental exposures are relevant in the low dose range) used to generate the slope factor. The EPA has used its default linear model to estimate risks in the low dose range citing lack of carcinogenic mode of action information. Thus, should this information become available, the low dose carcinogenic risks for arsenic may be evaluated differently.

Absence of Inhalation Toxicity Criteria - Although toxicity information is generally available for the most significant chemicals and exposure routes in this HHRA, there were some volatile COPCs in this HHRA for which no inhalation toxicity criteria (RfDs or cancer slope factors) exist. In the absence of data, either the oral RfD or oral SF was used to evaluate inhalation exposures. The letter "R" on Table 10 notes these instances. This assumes that the chemical is equitoxic by both routes (oral and inhalation). It is more conservative to evaluate these chemicals for inhalation exposures than to not evaluate them at all. Thus, this method potentially overestimates inhalation risks for COPCs evaluated as such. This uncertainty is not applicable however to the inhalation RfCs or slope factors for the COPCs which showed exceedances of their Tier 1 RBSLs (benzene, naphthalene, and arsenic) at this SWMU.

The development of an RBSL for lead, based on pharmacokinetic modeling (the USEPA Adult Lead Model) is inherently uncertain. These uncertainties relate to whether the model is capable of fully accounting for all significant variables that affect blood lead levels and whether selected input values that cannot be measured, are accurate, especially for future, hypothetical populations. In addition, the use of this model for the trespasser is highly uncertain since it is not known whether an adolescent (who is not pregnant) is more sensitive to the effects of lead than the developing fetus of a pregnant adolescent.

3.6.5 Risk Characterization

Uncertainties in the risk characterization portion of the risk assessment for the site are a combination of the uncertainties associated with both the dose-response assessment and the exposure assessment. As discussed above, the assumptions and parameters used for both the dose response and exposure assessments are extremely conservative. In addition, since the toxicity criteria and exposure parameters are combined in the risk characterization, the conservatism is compounded.

3.6.6 Uncertainty Analysis Summary

This Tier 1 HHRA includes uncertainties and conservative assumptions that, in general, effectively combine to overestimate the potential current and future exposures. The major sources of uncertainty contributing to the conservatisms in this HHRA are summarized below:

- Biased SWMU sample collection
- Use of maximum concentrations as representative concentrations
- Compounding effect multiple conservative exposure parameters
- No meteorological factor adjustment

The net effect of the uncertainties of this HHRA is the generation of risk and hazard estimates that probably far exceed any true exposure conditions that currently exist or which could possibly exist in the future.

4.0 CONTAINMENT

SWMU S-18 was placed directly on slag fill and there is no engineering containment structure, such as a liner or cover, in place. However, SWMU S-18 is surrounded by slag piles on the west, and, partially, the north and east sides which generally contain surface water runoff within the SWMU area. The southern portion of the fill area slopes toward the south into a small basin contained by the surrounding slag piles. Surface water can leave the area to the southeast. Additionally, the extreme northern area of the SWMU S-18 area slopes toward the former slag reclamation area (Figure 1). There is no cover material on the lime dust or kish piles and, therefore, the waste material is exposed to rain and wind.

The topography at SWMU S-18 is such that surface runoff can leave the site on the southeastern and northeastern sides. There are no drainage channels or ditches that collect surface water runoff and direct the flow to Lake Erie; rather, the surface water runs off the area via sheet flow across the slag surface. The runoff drains to both the former slag reclamation area to the north and to the access road to SWMU S-18 to the southeast, and eventually infiltrates into the slag material because of the porous nature of surrounding areas.

5.0 CONCLUSION

Based upon the data collected and evaluated during the investigations, the following conclusions can be made:

- The type of material landfilled is a dry dirt-like material placed on top of steel slag. There are no engineering containment structures in place.

- The 1992 TCLP extract concentration indicates that metals in the lime and kish material stockpiled at the SWMU does not exceed TCLP criteria.

- In the 2000 analysis, the concentration of lead in the TCLP extract in the surficial material in kish in SWMU-S-18 does exceed TCLP criteria. However, lead was not detected in the same samples in the SPLP extraction analysis. Lime was determined to be non-hazardous.

- The 1994 total VOC, SVOC, and metals analyses of the kish material indicated the presence of four SVOCs; [benzo(a)fluoranthene, benzo(ghi)perylene, fluoranthene, and indeno(1,2,3-cd)pyrene] at low concentrations. All eight metals analyzed (antimony, arsenic, cadmium, chromium, lead, nickel, selenium, and thallium) also were detected in the sample.

- 2000 SPLP analysis indicated that 11 of the 12 metals detected in the total-analysis samples have the potential to leach from the surface materials.

- Groundwater results indicate that SWMU S-18 has not impacted the shallow fill unit groundwater beneath the SWMU. Additionally, the SWMU is located within areas determined to be historical US Army Corp of Engineers dredge spoils disposal grounds. The analytical results from the deeper "B" wells (downgradient MWN-5B and upgradient MWN-14B) indicate that the sand unit may have been impacted by an on-site source. Because of the presence of U.S. Army Corps of Engineer drudge spoils in this unit; the contribution of SWMU S-18 to groundwater contamination is not known.

- The results of the Tier I human health risk assessment indicate that direct contact with antimony, arsenic, thallium, and/or lead in surficial materials poses a potential non-carcinogen risk to future commercial/industrial and/or construction workers.

- Additionally lead in surface SWMU material is found at levels higher than Tier 1 RBSLs for the future utility maintenance worker and trespasser scenarios. In subsurface SWMU material, the representative concentration of lead exceeds the future construction worker and future utility/maintenance worker scenario RBSLs.

Based on these results and in accordance with the Work Plan, further evaluation will be completed during the Corrective Measures Study (CMS) and may include a Tier 2 assessment or an evaluation of corrective measures.

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SWMU ASSESSMENT REPORT
TAR PIT ADJACENT TO SPL LANDFILL
(SWMU S-23)

BETHLEHEM STEEL CORPORATION
LACKAWANNA, NEW YORK

SEPTEMBER 2004

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1.0 INTRODUCTION

This report documents the results of an environmental assessment of the Tar Pit at Bethlehem Steel Corporation's (BSC's) Lackawanna, New York facility. The Tar Pit was identified by the United States Environmental Protection Agency (USEPA) as Solid Waste Management Unit (SWMU) S-23 in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (USEPA NEIC 1988). The area was used to dispose of coal tar material from coking operations, tar tank cleaning, and coke breeze. The USEPA required that a RCRA Facility Investigation (RFI) of this, and other SWMUs at the BSC facility be completed in accordance with the Administrative Order on Consent (AOC) signed by BSC and USEPA in 1990 (USEPA 1990). The RFI has been conducted in phases (Phases I, IIA, IIB, IIC, and III), and includes field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. This report evaluates SWMU data available to BSC as of November 2001.

1.1 Description

SWMU S-23 is located in the central portion of Zone 4 of the Slag Fill Area (SFA) as shown in Figure 1. SWMU S-23 is an irregularly shaped pit, which surrounds the Spent Pickle Liquor (SPL) Landfill (which is designated as SWMU S-16) on three sides. SWMU S-23 is approximately 500 feet in length across its longest dimension and 102 feet across its widest portion. The unit is presently covered with a mixture of "pea" stone (imported fill) and gravel-sized slag, mounded to a height of approximately 10 feet above grade [620 feet above mean sea level (amsl)]. The SWMU is highest where it adjoins with a synthetic cover, which currently is over SWMU S-16. The stone cover gradually slopes to lower elevations (i.e., at grade) near the edges of the unit. The surrounding grade level is approximately 610 feet amsl. The surface of the cover material at SWMU S-23 is sporadically vegetated (approximately 30 percent) and consists primarily of weeds, several small shrubs, and trees. Below the unit is approximately 50 feet of slag material, below which is federal dredge spoils.

Groundwater is approximately 570 feet msl, which is approximately 40 feet below grade surrounding the SWMU. The exact depth of the pit is not known. Soil borings advanced in 1994 along the edge of the SWMU suggest that the pit extends 6 feet below ground surface.

Additionally, in isolated discrete areas, a tar-like material is visible at the surface. Each of these areas are less than two square feet but are exposed to wind and rain. These areas were not documented on the 2000 site visit, but have been observed on the unit in previous years.

1.2 History

According to the RFA, SWMU S-23 was used to dispose of coal tar material from coking operations, tar tank cleaning, and coke breeze. The pit was ultimately covered with slag to minimize direct contact of materials placed in the unit with surface water and the surrounding atmosphere.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (US Army Corp) show that dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the SFA, including the area under SWMU S-23. The potential impact of these dredge spoils to groundwater beneath the site, especially in the sand unit in the SFA is further assessed in the RFI.

On February 20, 1996, BSC filed a declaration in the Erie County Clerk's office limiting future use of the property around and including SWMU S-23. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevents the installation and operation of extraction or water wells for purposes other than environmental remedial use. A copy of the Declaration of Conditions, Covenants and Restrictions is attached as Attachment A.

Site inspections were conducted in September 1995 and September 1996 by personnel from Dames & Moore. An additional inspection was conducted in July 2000 by personnel from URS. Observations made during the three site inspections are consistent with descriptions presented in Sections 1.1 and 4.0 of this report. Documentation of the 1996 and 2000 site visits are provided in Appendix A.

2.0 SAMPLING AND ANALYSIS

Waste material was sampled in 1994 as part of the Phase II-B of the RFI. Sampling was conducted as outlined in the Phase II-B Work Plan (BSC 1994). Soil samples were also collected in 2001 as part of the Supplemental Ecological Risk Investigation of the RFI (Ogden 2000).

Groundwater near SWMU S-23 was sampled periodically starting in 1986 and continuing into 2001. Groundwater sampling was conducted in accordance with the Contingency Closure and Post Closure Plan (BSC 1986, (revised 1987), Phase I Work Plan (1990), and Phase II-B of the RFI (1993), Phase II-C Work Plan (1994), the Natural Attenuation Phase 2 Groundwater Study (1997), and the Comprehensive Well Sampling Program (1999a). A complete list of site-specific compounds targeted for analysis in the site investigations is provided in Table 1 followed by data qualifiers. Laboratory analytical reports are provided in Section II of the RFI. Sample records and boring logs are included in Appendix B.

2.1 RFI Sampling

2.1.1 Waste Samples

Waste samples were collected from SWMU S-23 during a Phase II-B RFI in June 1994. Two borings were drilled and sampled: boring SWMU-S23-1 was 46 feet in depth and SWMU-S23-2 was 41.5 feet in depth. Standard split spoon samples were taken generally at two-foot intervals. Native sediments were encountered at the bottom of each borehole. The materials encountered during sample collection were described as slag: either gray, greenish gray, or brown in color. At depths less than 10 feet below ground surface, oil-product and tar-like materials were observed in both borings. The tar deposits in the borings S-23-1 and S-23-2 range from 3- to 5-feet thick. In addition, strong naphthalene-like odors were noted in piezometer boring SWMU-S23-2 to a depth of 39 feet below ground surface.

Composite samples were collected from the full length of each boring and analyzed for semi-volatile organics (SVOCs), metals, and cyanide. Grab samples were also collected from depth intervals having the highest photoionization detector (PID) field screening values (4 to 6 feet in both borings) and analyzed for volatile organic compounds (VOCs). Laboratory analyses included total constituent analysis, sample processing by the Toxicity Characteristic Leaching Procedure (TCLP) and the Synthetic Precipitation Leaching Procedure (SPLP), and analysis of the resulting liquid extracts. The extracts were analyzed for VOCs, SVOCs, metals, and cyanide.

2.1.1.1 Total Constituent Results

Analysis of the Phase II-B waste samples from June 1994 detected VOCs, SVOCs, several metals and cyanide. VOCs detected include benzene, toluene and xylenes. The highest composite concentrations, in general, were found in S23-2. Compounds ranged from a low of 30,000 micrograms per kilogram (ug/kg) of total xylenes to 48,000 ug/kg of benzene (S23-2). SVOCs ranged from a low of 140,000 ug/kg of phenol to 3,500,000 ug/kg of fluoranthene (S23-2). Metals ranged from 0.4 milligrams per kilogram (mg/kg) for mercury to 138 mg/kg for barium (S23-2).

The analytical results are summarized in Table 2.

2.1.1.2 SPLP Results

SPLP analyses were conducted to more closely mimic the effect of compounds leaching from the soil due to rainwater infiltration. The analyses were performed in accordance with the USEPA's SW846 Method 1312 protocols.

Extract analysis of Phase II-B core samples indicated that several VOCs, and SVOCs were detected above method detection limits. VOCs detected ranged from 0.28 milligrams per liter (mg/L) of total xylenes (S23-1) to 21 mg/L of methylene chloride (S23-2). The value for methylene chloride was flagged as an estimate during data validation due to calibration failure. Additionally, methylene chloride was not detected in the total constituent analysis of the solid phase sample. SVOCs ranged from 0.21 mg/L of fluorene (S23-1) to 22 mg/L of naphthalene (S23-2). Metals were not detected. Cyanide was detected in both borings ranging from 0.11 mg/L to 0.33 mg/L (S23-2).

The analytical results are summarized in Table 2.

2.1.1.3 TCLP Results

TCLP results were compared to regulatory concentration levels as listed in the 40 CFR Part 261. The concentration of benzene in the TCLP extract of the materials in SWMU S-23 does meet TCLP criteria.

The analytical results are summarized in Table 3.

2.1.2 2001 Supplemental Ecological Investigation

On June 6, 2001 as part of the Supplemental Ecological Risk Investigation of the RFI conducted by AMEC, two surface soil samples (AMEC S23A and AMEC S23B) were collected from SWMU S-24. The sample locations are shown on Figure 1. The samples were collected as part of a site-wide Ecological Risk Assessment but the results are also helpful in evaluating the materials within the SWMU.

The soil samples were collected from surface to 6-inches below grade. The samples were analyzed for total VOCs, SVOCs, metals, and cyanide. The sampling was conducted under the Supplemental Ecological Risk Investigation Work Plan (Ogden 2000).

2.1.2.1 2001 Soil Results

No VOCs were detected in either of the samples. Ten SVOCs, thirteen metals and cyanide were detected in the samples. SVOC concentrations ranged form 140 ug/kg for naphthalene in S23B to 57,000 ug/kg in S23A. Concentrations for pyrene, fluoranthene and benzo(a)pyrene in S23A were rejected during data validation.

Metals concentrations ranged from 1.1 mg/kg for mercury to 147,000 mg/kg of calcium (both from AMEC S23A sample). Cyanide was also detected in both samples. The detected analytes are presented on Table 4.

2.2 Groundwater Sampling

Data from five monitoring wells (MW-1D1, MW-1D6, MW-1D7, MW-1D8 and MWN-12) were used to evaluate groundwater quality near SWMU S-23. All five wells are considered downgradient of SWMU S-23. A groundwater mound is present in the fill unit beneath SWMU S-23 and S-16, and therefore, there are no upgradient wells to use as comparison for SWMU S-23. The topography of the unit causes the groundwater to mound and flow radially away from the SWMU S-16/S-23 area (Figure 2). The location of the monitoring wells and groundwater elevation contours are shown in Figure 2 and Figure 3.

2.2.1 Groundwater Results

As part of the Contingency Closure and Post Closure Plan for SWMU S-16 (HWM-1B), the wells surrounding SWMU S-16 and SWMU S-23 have been sampled on at least a semi-annual basis since 1987. The analytical results are presented in Table 5. For comparison purposes, the last five sample events (April 1999, November 1999, April 2000, October 2000 and April 2001) were evaluated to assess whether the material stored in SWMU S-23 has the potential to impact the groundwater beneath the site.

Based on the soil sampling data, VOCs, SVOCs, and metals were all present in detectable concentrations. Subsequent SPLP analysis of these soils indicated that numerous VOCs and SVOCs were detected above method detection limits. Four VOCs (benzene, methylene chloride, toluene, and total xylenes) and eight SVOCs (acenaphthylene, 2,4-dimethylphenol, fluorene, 3-methylphenol and 4-methylphenol, 2-methylphenol, naphthalene, phenanthrene, and phenol) were present in the SPLP extract. Methylene chloride was not detected in the Total Constituent analysis and may be a laboratory contaminant.

Of those compounds detected in the SPLP analysis, all three VOCs and 6 of the 8 SVOCs (acenaphthylene, fluorene, 3-methylphenol & 4-methylphenol, naphthalene, phenanthrene and phenol) were detected in the monitoring wells at least once during the semi-annual groundwater monitoring between April 1999 and April 2001. The analytical results are summarized in Table 6.

Concentrations of the VOCs ranged from 1.5 µg/L of toluene to 94 µg/L of total xylenes, both in MW-1D8. SVOCs ranged from 1.8 µg/L of 3-methylphenol and 4 methylphenol in MW-1D1 to 100 µg/L of naphthalene in MW-1D8. Since no upgradient wells are present within the immediate vicinity of the SWMU, it cannot be determined if the SWMU materials have had an additive effect on the groundwater beneath Zone 4 of the SFA.

2.3 Summary of Sampling Results

The concentration of benzene in the TCLP extract of the materials in SWMU S-23 does meet TCLP criteria.

Total constituent analysis of the composite and grab samples collected from the SWMU indicated that VOC, SVOCs and metals were present at detectable levels. SPLP analysis of the soils indicated that several VOCs and numerous SVOCs have the potential to leach from the soil.

Groundwater sampling has indicated that most of the VOCs and SVOCs detected in the SPLP extract are also present in the groundwater downgradient of SWMU S-23. Historical documentation shows that from at least 1937 to 1948, the US Army Corps dredge spoils obtained form the Buffalo River and Outer Harbor were placed in Lake Erie in the areas subsequently occupied by the SFA. The dredge spoils disposal area includes the western end of groundwater Zone 4, including the area below S-23. Although this review of groundwater analytical results indicates groundwater impacts are present downgradient of SWMU S-23, because of the lack of upgradient monitoring wells; the potential impacts to groundwater due to the U.S. Army Corps dredge spoil disposal; and the presence of the SPL Landfill, the contribution of this particular SWMU to groundwater contamination cannot fully be determined.

Further evaluation of the compounds detected in the SWMU material and the groundwater within Zone 4 is presented in the Human Health Risk Assessment in Section 3.0.

3.0 RISK ASSESSMENT

A human health risk assessment (HHRA), as described in the *Human Health Risk Assessment Work Plan* (BSC, 1997), was conducted for SWMU S-23, Tar Pit adjacent to the Lime Stabilized Pickle Liquor Sludge/Slag Landfill (SWMU S-16). The results of the Tier 1 Human Health Risk Assessment (HHRA) are presented here and are organized into the following sections: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization and Uncertainty Analysis. The major components of this HHRA have previously been presented in Human Health Risk Assessment Report, Part IV of this RFI Report. Therefore, the following sections provide summary overviews of previously presented information. This section, therefore, serves as a summary report, bringing together all associated and related work from previous risk assessment deliverables, and providing the conclusions of the SWMU-specific risk assessment.

3.1 Data Evaluation

A list of 96 constituents of potential interest (COPIs) was developed for the BSC Lackawanna, New York facility based on USEPA and industry studies (BSC 1998). The list contains hazardous constituents that could be present in the waste streams as a result of integrated iron and steel plant operations, such as those historically conducted at the Lackawanna facility. ID No. 1 (BSC 1998) established the chemicals of potential concern (COPCs) for each SWMU at the Lackawanna Facility. The COPCs were determined by sequentially applying the following criteria, as applicable, to each COPI on a medium by medium basis for each SWMU: 1) the chemical was detected in at least 5% of the samples, 2) the chemical was detected in at least one sample at levels above background (i.e., the maximum concentration was above background; for chemicals in surficial SWMU material only), and 3) the chemical was positively detected in at least one sample at levels above applicable screening criteria [i.e., the maximum concentration was greater than the screening criteria: USEPA Region III Risk Based Concentrations (RBCs), USEPA Soil Screening Levels (SSLs), or NYSDEC Ambient Water Quality Standards and Guidance values]. SWMU S-23 consists of a tar pit covered with a mound of fill and gravel-sized slag to a height of approximately 10-feet above grade. Accordingly, surface samples were not collected at this SWMU. However, recent visual observations at the SWMU indicate that subsurface SWMU material may be migrating to the surface, beyond the gravel cover. The extent to which the subsurface material has reached the surface is unknown. Because most of the

SWMU cover appears to be unaltered, it is not entirely appropriate to consider that exposure to the surface material is equivalent to the subsurface material, as is the procedure according to ID No. 2 in the absence of surface data. Thus, this HHRA only evaluates the subsurface material and Zone 4 groundwater. In accordance with ID No. 1, a background comparison was not made for the subsurface SWMU material in this report.

The sampling data for SWMU S-23 (as presented in Section 2.0 of this report) were evaluated in order to identify the site-related COPCs for the SWMU. COPCs were originally determined in ID No. 1 (BSC 1998), however, as some screening criteria have been revised since ID No. 1 was submitted (USEPA 2000), and as additional groundwater samples have been collected, this screening process has been updated and is presented in Tables 7 and 8. Table 7 presents the screening of the subsurface SWMU material, and Table 8 presents the screening of groundwater. Two inorganic (arsenic, thallium) and thirteen organic COPCs (volatiles and semivolatiles) were identified in subsurface SWMU material, and 12 volatile organic COPCs were identified in groundwater. Representative concentrations were then determined for each COPC; these representative concentrations are presented in Table 9. If the sample size for a dataset is ten or more, the 95% upper confidence limit of the mean was used as the representative concentration. For those datasets with sample sizes of less than ten, the maximum detected concentration was used. Two samples were collected of the subsurface material in SWMU S-23; therefore, the maximum concentration was used to represent all COPCs in subsurface material. SWMU S-23 is located in Groundwater Zone 4 (BSC 1998), for which more than ten samples have been collected. Therefore, the 95% UCL was used as the representative concentration for each of the COPCs. If a chemical's representative concentration exceeds its saturation limit in soil, or its solubility limit in groundwater, this is noted in Table 9. Exceedance of either of these levels may indicate the presence of free product. The COPCs and their representative concentrations are used in the SWMU S-23 risk characterization (Table 9).

3.2 Exposure Assessment

The exposure assessment conducted for SWMU S-23 included a review of current and future human receptor scenarios and potential exposure pathways, as related to COPCs. In general, exposure pathways by which a human receptor could come into contact with SWMU material are defined by four components (USEPA 1989):

- A source and mechanism of constituent release to the environment;
- An environmental transport mechanism;
- A point of potential human contact with the affected medium, and
- A route of entry into humans.

If any one of these components is missing, the pathway is considered incomplete and does not contribute to receptor exposure.

Human Health Risk Assessment ID No. 2 (BSC 1999b) presented the current and future human receptor scenarios and potentially complete exposure pathways for each of the SWMUs identified at the Lackawanna Facility. ID No. 1 (BSC 1998) identifies the COPCs; these COPCs were also integral in determining complete exposure pathways, based on their presence in each media (*i.e.*, surface SWMU material, subsurface SWMU material or groundwater) and their volatility (*e.g.*, inorganics in groundwater do not present a complete exposure pathway as they are not volatile and groundwater is not used as a drinking water source). Potential exposure pathways for SWMU S-23 are presented in Table 10 and discussed below.

For SWMU S-23, the potential receptor scenarios include a current non-BSC commercial/industrial worker, a future commercial/industrial worker, a future construction worker, a future utility/maintenance worker, a trespasser, a future marina worker, a future greenway user, a future fenceline resident, and a present fenceline resident. Potentially complete exposure pathways were previously established in ID No. 2 for each receptor and are summarized below. Scenarios were developed based on current land use patterns, unrestricted future commercial/industrial development, and potential future recreational uses.

For the future commercial/industrial worker scenario, the future utility/maintenance worker scenario, the future construction worker scenario and the trespasser scenario, the following pathways were determined to be complete: inhalation of vapors from subsurface SWMU material and inhalation of vapors from Groundwater Zone 4. The future commercial/industrial worker scenario may also be potentially exposed to indoor vapors from groundwater or subsurface SWMU material, should a building be placed on the SWMU under current conditions. The future construction worker and future utility/maintenance worker scenarios may additionally be exposed via direct contact with subsurface SWMU material (ingestion, dermal contact, vapor and particulate inhalation) during potential future digging activities. The only potentially complete exposure pathway for the current non-BSC commercial/industrial workers scenario, future marina worker scenario, future greenway user scenario, and present and future fenceline residential scenarios is inhalation of vapors in subsurface SWMU material. A detailed description of the potentially exposed receptor scenarios and pathways for SWMU S-23 can be found in ID No. 2 (BSC 1999b) and a summary is provided in Table 10.

3.3 Toxicity Assessment

A toxicity assessment characterizes the relationship between the exposure to a COPC and the frequency of adverse health effects that may result from such an exposure (dose-response). The end result of the dose-response assessment is the determination of human uptake levels that provide an adequate measure of protection to exposed persons for carcinogenic and noncarcinogenic endpoints. The derivation of acceptable levels of exposure (*e.g.*, risk-based screening levels; RBSLs) and the manner in which these levels are used in this HHRA are discussed below.

Tier 1 RBSLs were calculated and compared to the representative SWMU S-23 COPC concentrations. RBSLs are defined as concentrations of COPCs in media that are not expected to produce adverse health effects under assumed exposure conditions. Tier 1 RBSLs were developed using information previously defined and described in detail in the Work Plan and ID No. 2; this information is summarized here. The equations used to calculate the RBSLs follow basic USEPA risk assessment principles (USEPA 1989; 1996). Conservative exposure parameters, as defined by the ASTM Standard (ASTM 1995) and USEPA guidance (USEPA 1989; 1991a, and 1991b), and USEPA toxicity criteria (USEPA 2001) were inputs into these equations to develop the RBSLs. As some of the toxicity criteria have been revised by the USEPA since originally presented in ID No. 1, the criteria for all chemicals have been re-presented in Table 11 of this HHRA. The above information was used to calculate RBSLs for COPCs in SWMU material and groundwater, for each of the nine exposure scenarios.

For this risk assessment, vapor dispersion modeling was performed to enable estimation of potential exposure to airborne COPCs emanating from subsurface SWMU material. Modeling was performed with the USEPA Industrial Source Complex Short-Term Model (ISCST3, version 99155) and with meteorological data collected at a monitoring station at the Lackawanna facility in 1991. For current non-BSC worker scenario, RBSLs were calculated based on the maximum estimated impacts in the northern, middle, and southern regions of the facility. For this assessment, the most conservative RBSL (*i.e.*, lowest) of the regions was used to represent the current non-BSC worker scenario. Particle dispersion modeling was not performed for RBSLs; instead, it was conservatively assumed that the receptor is actually present on the SWMU.

It should be noted that, in groundwater, many of the RBSLs calculated were greater than the chemicals' solubility in water. This indicates that, based on the predicted amount of chemical volatilization, pure product in the groundwater would not pose an inhalation health threat from these chemicals. The solubility limits of these chemicals are indicated in Table 12.

Similarly, some of the RBSLs calculated for the COPCs in subsurface SWMU material may have been determined to be health protective at concentrations that are greater than the chemical's saturation limit in soils. However, it is important to consider that chemical emissions from soil to air reach a plateau at the chemical's saturation limit, and volatile emissions will not increase above this level, regardless of how much more chemical is added to the soil. In other words, the exposure concentration for an inhalation-only scenario cannot exceed a chemical's saturation limit. Furthermore, RBSLs that are above the saturation limit are not likely to pose increased risks or hazards (USEPA 1996). Therefore, RBSLs that are based only upon the inhalation pathway are capped at the saturation limit for that chemical, and "> sat" is indicated in such situations (Table 12). RBSLs that are not based solely on inhalation were not capped at the saturation limit, as the potential exposure concentrations are greater than the saturation limit for direct contact scenarios (*e.g.*, dermal contact, ingestion).

Lastly, some of the RBSLs for COPCs in SWMU material were determined to be health protective at levels that are greater than 1,000,000 parts per million (mg/kg); such cases are noted by the following indicator ">1,000,000" in Table 12. For those RBSLs that were based on inhalation, if a calculated RBSL is greater than both the saturation limit in soil and 1,000,000 mg/kg, ">1,000,000" is shown in Table 12 as it is more indicative of the level of health-protectiveness.

A comparison of the representative COPC concentrations to RBSLs for each of the exposure scenarios is presented in Table 12. This comparison provides a preliminary screening of potential risk to the specific receptor populations and exposure pathways identified for this SWMU.

The representative concentration of benzene in subsurface SWMU material exceeds indoor and ambient vapor inhalation RBSLs for the future commercial/industrial worker scenario, while naphthalene in subsurface SWMU material exceeds the indoor inhalation RBSL only. For the future construction worker scenario, representative concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene and naphthalene in the subsurface SWMU material exceed respective direct contact with SWMU material RBSLs. In addition, the representative concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-c,d)pyrene and naphthalene in subsurface SWMU material exceed respective direct contact RBSLs for the future utility/maintenance worker scenario. For all other scenarios, chemicals and pathways, the representative concentrations are below the respective RBSLs, and therefore, are not evaluated further.

In accordance with Part IV of this RFI report, those COPCs that do not exceed the Tier 1 RBSLs are not evaluated further. For those COPCs that exceed Tier 1 RBSLs, the risk to human health is evaluated further in the Tier 1 Risk Characterization.

3.4 Risk Characterization

Risk characterization involves the estimation of the magnitude of potential adverse health effects of the COPCs, and summarizing the nature of the health impact to the defined receptor populations. It combines the results of the toxicity and exposure assessments to provide numerical estimates of health risk.

Those COPCs that exceeded an RBSL were further evaluated in the Risk Characterization, or Tier 1 HHRA. A Tier 1 HHRA provides an estimate of risk and hazard based on a comparison of the RBSL (*i.e.*, health-protective levels) to the COPC concentrations (*i.e.*, site-specific levels). Specifically, for those COPCs that exceeded an RBSL, a screening-level hazard index (SLHI) was calculated to evaluate noncarcinogenic health effects, and a total screening-level cancer risk

($SLCR_{total}$) was calculated to evaluate carcinogenic effects. The SLHI and $SLCR_{total}$ methodologies are presented in the Work Plan (BSC 1997). The Tier 1 HHRA results are presented in Table 13. When assessing the risks of naphthalene in subsurface SWMU material, the concentrations (11,000 mg/kg) was capped at the saturation limit (371 mg/kg), for inhalation-only scenarios, as the rate of volatilization from soil will not exceed this value.

3.4.1 Noncarcinogenic Hazards

The noncancer hazards were assessed in this HHRA using a hazard quotient approach (USEPA 1989). For each COPC, the noncarcinogenic RBSL was compared to the COPCs representative concentration to determine the screening level hazard quotient (SLHQ) for that chemical. The equation is as follows:

$$SLHQ = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}}$$

SLHQs for each chemical are summed to create a total Screening Level Hazard Index ($SLHI_{total}$) for each pathway. The smaller the SLHQ/SLHI, the greater the degree of protection for that pathway. SLHQs are comprised of only those chemicals in those exposure scenarios that exceed their respective RBSLs. Based on USEPA methodology (USEPA 1989) and, if the SLHI is less than 1, the risks are considered to be negligible. Those $SLHI_{total}$s values that exceed 1 were further evaluated by developing target organ-specific SLHIs. This process is appropriate as only certain chemicals affect similar biological target endpoints; it is only relevant to quantify the additive effects of these chemicals. This process is illustrated in Table 13.

The future commercial/industrial worker scenario was evaluated for exposure to both indoor and ambient air. As a worker will not be exposed to both ambient and indoor air simultaneously during the workday, the inhalation of ambient and indoor air SLCRs were evaluated separately. The $SLHI_{total}$ for the indoor future commercial/industrial worker scenario is 73, as a result of inhalation of benzene (SLHQ = 69.6) and naphthalene (SLHQ = 3.6) vapors from subsurface SWMU material. The $SLHI_{total}$ for the future commercial/industrial worker scenario working in ambient air is 2.2, as a result of inhalation of benzene (SLHQ = 2.2) in subsurface SWMU material. The $SLHI_{total}$ for the future construction worker scenario is 35; a result of direct contact (including vapor inhalation) with naphthalene in subsurface SWMU material. For the future utility/maintenance worker scenario, the $SLHI_{total}$ is 7.0 resulting from direct contact (including vapor inhalation) with naphthalene in subsurface SWMU material.

As each of the $SLHI_{total}$s are greater than 1, each is subject to further evaluation by target organ. It was only necessary to break this down for the future indoor commercial/industrial worker scenario, as it was the only scenario with RBSL exceedance for more than one noncarcinogenic chemical (for the future construction and utility/maintenance worker scenarios, the total upper respiratory system SLHI equals the $SLHI_{total}$ as naphthalene is the only chemical evaluated in the risk characterization). For the indoor commercial/industrial worker scenario exposed to indoor vapors, the blood/immune system SLHI is 69.6 (benzene in subsurface SWMU material) and the upper respiratory system SLHI is 3.6 (naphthalene in subsurface SWMU material).

3.4.2 Carcinogenic Risk

In a human health risk assessment, carcinogenic health risks are defined in terms of the probability of an individual developing cancer over a lifetime as the result of exposure to a given chemical at a given concentration (USEPA 1989). The incremental probability of developing cancer over a lifetime (*i.e.*, the theoretical excess lifetime cancer risk) is the additional risk above and beyond the cancer risk an individual would face in the absence of the exposures characterized in this risk assessment. In this Tier 1 RA, cancer risk was evaluated according to the following equation:

$$SLCR = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}} \; x \; \text{Target Risk Level}$$

Cancer risks are summed regardless of the differences in target organ, weight-of-evidence for human carcinogenicity, or potential chemical interactions (*e.g.*, antagonistic or synergistic effects). This approach is consistent with USEPA's current approach to carcinogenic effects, which is to assume effects are additive unless adequate information to the contrary is available (USEPA 1989). Based on USEPA methodology (USEPA, 1989) and as discussed in the Work Plan, if the total screening level cancer risk ($SLCR_{total}$) for each receptor/pathway is less than 1 x 10^{-4}, the risks are considered to be negligible.

With the exception of the indoor commercial/industrial worker scenario and the future construction worker scenario, the SLCRs are below the acceptable risk benchmark of 1 x 10^{-4}.

For the future commercial/industrial worker scenario, the $SLCR_{total}$ for the indoor worker scenario is 3 x 10^{-4} from benzene in subsurface SWMU material. The $SLCR_{total}$ for the future commercial/industrial outdoor worker scenario is 1 x 10^{-5} from benzene in subsurface SWMU material. The $SLCR_{total}$ for the future construction worker scenario is 3 x 10^{-4}, attributable to direct contact with benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-c,d)pyrene in subsurface SWMU material. Finally, the $SLCR_{total}$ for the future utility/maintenance worker scenario is 7 x 10^{-5}, attributable to direct contact with benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and indeno(1,2,3-c,d)pyrene in subsurface SWMU material.

3.5 Conclusions

The results of the Tier 1 HHRA indicate that levels of benzene, naphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-c,d)pyrene in subsurface SWMU material exceed noncarcinogenic and/or carcinogenic RBSLs and produce calculated hazard indices greater than the Tier 1 hazard benchmark of 1.0 or risk levels greater than the Tier 1 carcinogenic benchmark of 1 x 10^{-4}. Specifically, for the future commercial/industrial worker scenario, the calculated hazard index for benzene in subsurface SWMU material (both indoor and ambient exposure) and naphthalene in subsurface SWMU material (indoor exposure) is greater than the Tier 1 noncarcinogenic benchmark even when different endpoints are considered. The calculated risk for benzene in subsurface SWMU material (indoor inhalation) also generates a calculated risk of 3 x 10^{-4} that is greater than the Tier 1 carcinogenic benchmark 1 x 10^{-4}.

For the future construction worker scenario, the calculated hazard index (35) for naphthalene in subsurface SWMU material is greater than the Tier 1 noncarcinogenic benchmark. Additionally, the calculated risk level due to benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-c,d)pyrene in subsurface SWMU material 3 x 10^{-4} is greater than the Tier 1 carcinogenic benchmark. Lastly, for the future utility/maintenance worker scenario, the calculated hazard index due to naphthalene in subsurface SWMU material (7) exceeds the Tier 1 noncarcinogenic benchmark.

It is also important to note that, as indicated in Table 7, many of the COPCs in subsurface SWMU material exceed their saturation limits in soil. This HHRA did not include the evaluation of surface SWMU material, as it consists of a gravel cover. As mentioned earlier, it is apparent that subsurface material may be migrating upwards through this surface material. It may be assumed that this migrating material is at a minimum, equivalent in content and concentration of the subsurface SWMU material. Based on these results and in accordance with the work plan, further evaluation will be completed during the Corrective Measures Study (CMS) and may include a Tier 2 assessment or an evaluation of corrective measures. The uncertainties inherent in these conclusions are presented in the following Uncertainty Analysis.

3.6 Uncertainty Analysis

There are multiple sources of uncertainty that may be identified for any risk assessment. These include, among others, uncertainty associated with the toxicity criteria used to derive dose-response factors, uncertainties associated with exposure parameters used in the exposure assessment, and uncertainties associated with combining exposure parameters and toxicity criteria to characterize risk.

In the development of any health assessment, some level of uncertainty is introduced each time an assumption is relied upon to describe a dynamic parameter. Some assumptions have a significant scientific basis while others do not, which may result in the selection and use of conservative, default exposure parameters in the exposure assessment. The selection of multiple conservative assumptions in the exposure assessment generally results in an overestimation of potential health risks associated with exposure to specific chemical constituents. The primary areas of uncertainty for this risk assessment are qualitatively discussed below.

3.6.1 Exposure Scenarios

The evaluation of exposure scenarios that are not necessarily representative of realistic exposures based on current and future land use creates uncertainty in the overall risk potential of the SWMU and the site. The exposure scenarios evaluated in this risk assessment may not be realistic in terms of planned redevelopment for the site. The placement of a building on this SWMU is not planned nor is it feasible. Thus, Tier 1 risks are generated for the indoor construction/worker scenario that does not currently exist, nor is it likely to exist in the future.

3.6.2 Site Sampling and Representative Concentrations

SWMU sample locations were selected in an attempt to identify the highest concentrations of chemicals at the site. Sample biasing was accomplished based on visual observations and photoionization detector readings. Thus, the sampling activities are thought to have characterized the most highly impacted areas of the SWMU and are not an average. This is conservative, as a potential receptor is not expected to remain on, or inhale particulates from, one portion of the SWMU for his or her entire exposure duration. Therefore, it is believed that the maximum concentrations used in this HHRA are likely to represent the true maximum site concentrations.

It should also be noted that, for benzene and naphthalene in groundwater, and for all of the COPCs in subsurface SWMU material, the maximum concentration was used as the representative concentration in this HHRA. This was either because not enough samples were collected to calculate a 95% UCL, or because the calculated 95% UCL exceeds the maximum concentration. The representative concentrations were used to compare to the RBSLs calculated for this HHRA, and ultimately determine the chemicals of interest in this HHRA. Use of the maximum concentrations of the biased sampling is a very conservative methodology utilized in this HHRA.

3.6.3 COPC Selection Process

The COPCs evaluated for SWMU S-23 were identified in the Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC, 1998). These chemicals were selected in part because of their representative concentrations exceeded Region III RBCs (USEPA, 2000) for residential scenarios.

Since no residential exposures are realistic for any of the on-site scenarios, some chemicals have been retained as COPCs that are not likely to pose a potential threat to most of the human receptors evaluated here.

The likely COPCs selected for this SWMU do not include any in the surface SWMU material, because a gravel cover is in place on the SWMU, consequently no samples have been collected. Recent visual observations at the SWMU, however, indicated that subsurface SWMU material may be migrating past the cover. Thus, any additional surface material sampling and results need to be considered in any future risk evaluations (Tier 2 Analysis) of this SWMU.

3.6.4 Exposure Parameters

Several conservative default exposure parameters (*e.g.*, inhalation rates, exposure frequency, exposure duration) were incorporated into the exposure assessment to define general population behavior. For example, for the industrial/commercial worker scenarios, default exposure parameters are intended to be conservative and representative of an individual who is consistently present at the site 24 hours a day, 250 days a year, in the area of highest concentration. It is more likely that the exposure of an industrial worker to a *particular SWMU* (i.e., SWMU material) on the Lackawanna site is limited to an average of only a few hours a day, 2 weeks year. Most parameters incorporated into the exposure assessment to define the receptor scenarios are conservative values and used to define a worst-case population behavior. The net effect of using multiple conservative exposure assumptions is the overestimation of potential health risks.

Additionally, for a receptor population such as an industrial worker or a resident (*i.e.* where exposure duration is greater than 250 days/year), exposure frequency typically is corrected in site-specific health risk assessments for the fraction of the year when outdoor exposure to soil will be limited due to severe weather conditions such as snow, ice, rain and freezing temperatures (USEPA, 1989). This factor is called a meteorological factor. Because of the geographical location of the Lackawanna site, a correction factor for weather conditions would be reasonable. In this Tier 1 human health risk assessment, exposure did not exclude days when the temperature is less than 32°F and not when there is snow cover or the ground was wet from other forms of precipitation. For this SWMU, the Tier 1 RBSLs were exceeded for the future commercial/industrial worker scenarios. Thus, applying a more realistic exposure frequency and a meteorological factor would result in higher RBSLs.

3.6.5 Toxicity Assessment

Noncarcinogenic Criteria- Toxicity information for many of the COPCs is limited for humans. Consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty will be associated with the calculated toxicity values. The USEPA derives reference concentrations (RfC; inhalation exposures) and reference doses (oral exposures) for chemicals using an uncertainty factor (UF) approach. The uncertainty factor for naphthalene, for instance, is 3000. This was derived by applying a UF of 10 to account for extrapolation of the mouse study to humans, another UF of 10 to account for sensitive humans, another UF of 10 to account for extrapolation from a LOAEL to a NOAEL, and a final UF of 3 to account for lack of an appropriate reproductive study. In general, the procedures used to extrapolate from animals to humans in toxicity studies include a conservative use of uncertainty factors so that potential effects on humans are likely overestimated rather than underestimated. It is widely accepted in the scientific community that low doses of toxicants may be detoxified by any one of several processes present in human organ-systems (Ames *et al.* 1987). As a result, humans may not react to the same degree as the population of genetically homogeneous laboratory animal populations used in standard bioassays.

Carcinogenic Criteria- USEPA cancer SFs are developed using variations of the Linear Multistage Model (LMS) for carcinogenicity. The LMS is highly conservative as it assumes linearity between dose and effect to zero dose, assuming no threshold for carcinogenicity. However, the human body has mechanisms to detoxify most chemicals particularly at low doses, and therefore many scientists believe that most, if not all carcinogens only cause cancer above a "threshold dose."

The carcinogenic COPCs evaluated for SWMU S-23 includes benzene. The inhalation slope factor for benzene are based on human data from occupational exposure studies, and thus an extrapolation from animal data is not necessary, thereby reducing the some uncertainty in the slope factors. However, there is significant uncertainty associated with the low dose extrapolation (environmental exposures are relevant in the low dose range) used to generate the slope factors. The EPA has used its default linear model to estimate risks in the low dose range citing lack of carcinogenic mode of action information. Thus, should this information become available, the low dose carcinogenic risks for benzene could be evaluated differently.

Absence of Inhalation Toxicity Criteria - Although toxicity information is generally available for the most significant chemicals and exposure routes in this HHRA, there were some volatile COPCs in this HHRA for which no inhalation toxicity criteria (RfDs or cancer slope factors) exist. In the absence of data, either the oral RfD or oral SF was used to evaluate inhalation exposures. The letter "R" on Table 9 notes these instances. It is more conservative to evaluate these chemicals for inhalation exposures than to not evaluate them at all. Thus, this method potentially overestimates inhalation risks for COPCs evaluated as such.

3.6.6 Risk Characterization

Uncertainties in the risk characterization portion of the risk assessment for the facility are a combination of the uncertainties associated with both the dose-response assessment and the exposure assessment. As discussed above, the assumptions and parameters used for both the dose response and exposure assessments are extremely conservative. In addition, since the toxicity criteria and exposure parameters are combined in the risk characterization, the conservatism is compounded.

3.6.7 Uncertainty Analysis Summary

This Tier 1 HHRA includes uncertainties and conservative assumptions that, in general, effectively combine to overestimate the potential current and future exposures. The major sources of uncertainty contributing to the conservatisms in this HHRA are summarized below:

- Evaluation indoor industrial/commercial worker scenario
- Biased SWMU sample collection
- Use of maximum concentrations as representative concentrations
- Compounding effect of multiple conservative exposure parameters
- No meteorological factor assumption
- Confidence in toxicity criteria

The net effect of the uncertainties of this HHRA is the generation of risk and hazard estimates that probably far exceed any true exposure conditions that currently exist or which could possibly exist in the future.

4.0 CONTAINMENT

SWMU S-23 is covered with a gravel surface with some vegetation present. There is no subsurface containment structure at the base of SWMU material. Surface water runoff from precipitation drains off the sloped sides and eventually infiltrate into the surrounding slag surface.

5.0 CONCLUSIONS

Based on review of the data the following conclusions can be made:

- The exact depth of the unit is not known.

- Total constituent analysis of samples obtained from borings performed within limits of SWMU S-23 detected several VOCs and numerous SVOCs. SPLP analysis results detected VOCs, SVOCs, and cyanide.

- The concentrations of benzene in the TCLP extract of the materials in SWMU S-23 do exceed TCLP criteria.

- Although no upgradient wells are present near SWMU S-23 due to a groundwater mound in the area, groundwater sampling shows that most of the VOCs and SVOCs detected in the SPLP analysis are also present in the groundwater downgradient of the SWMU.

- The SWMU is located within areas determined to be historical US Army Corps of Engineers dredge spoils disposal grounds. Additionally, SWMU S-23 is adjacent to the SPL Landfill. As such, the contribution of SWMU S-23 to groundwater contamination cannot be fully determined.

- The results of the Tier 1 HHRA indicate that for the future commercial/industrial worker scenario, ambient vapors from benzene in subsurface SWMU material, and indoor vapors from benzene and naphthalene in subsurface SWMU material generate calculated risks greater than the Tier 1, noncarcinogenic benchmark. Additionally, benzene (indoor inhalation) in subsurface SWMU material also generates a calculated risk greater than the Tier 1 carcinogenic benchmark.

- For the future construction worker scenario, naphthalene in subsurface is greater than the Tier 1 noncarcinogenic benchmark. In addition benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-c,d)pyrene in subsurface SWMU material generate cancer risks greater than the Tier 1 carcinogenic benchmark.

- For the future utility/maintenance worker scenario, naphthalene in subsurface SWMU material exceeds the Tier 1 noncarcinogenic benchmark.

Based on these results and in accordance with the work plan, further evaluation will be conducted during the CMS and may include a Tier 2 assessment or an evaluation of corrective measures.

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SWMU ASSESSMENT REPORT
DRUM LANDFILL
(SWMU S-28)

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LACKAWANNA, NEW YORK

SEPTEMBER 2004

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1.0 INTRODUCTION

This report documents the results of an environmental assessment of the Drum Landfill at Bethlehem Steel Corporation's (BSC's) Lackawanna, New York facility. The Drum Landfill, designated by the United States Environmental Protection Agency (USEPA) in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (USEPA 1988) as Solid Waste Management Unit (SWMU) S-28, was identified from an aerial photograph taken on September 30, 1982 as a pit, south of the Tar Decanter Sludge Landfill (SWMU S-13). According to the USEPA, it appeared as if drums were present in the southern portion of the trench. The USEPA has required that a RCRA Facility Investigation (RFI) of this and other SWMUs at the BSC facility be completed in accordance with the Administrative Order on Consent (AOC) signed by BSC and USEPA in 1990 (USEPA 1990). The RFI has been conducted in phases, and includes fieldwork consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property.

A preliminary SWMU assessment of SWMU S-28 was completed in 1993 (BSC 1993). The USEPA reviewed and commented on the assessment in 1994 (USEPA 1994). This SWMU S-28 assessment report provides additional information to further address the USEPA's comments. A copy of the USEPA comments is provided in Attachment A. This report evaluates SWMU data available to BSC as of November 2001.

1.1 Description

S-28 is located in the northwestern portion of the Slag Fill Area (see Figure 1) adjacent to the south side of the Tar Decanter Sludge Landfill (SWMU S-13) [also known as Hazardous Waste Management Unit (HWMU)-1A]. Further discussion of SWMU S-13 is presented in the SWMU S-13 Assessment Report and the RFI. SWMU S-28 is a relatively flat, moderately vegetated area. The area was identified in the RFA as a pit although there is no information available regarding the former pit's depth.

1.2 History

SWMU S-28 first appears in aerial photographs taken in September 1981 as a possible extension of a pit, which is now the closed Tar Decanter Sludge Landfill. However, because of the RCRA regulations and restrictions on SWMU S-13, imposed shortly after the pit was excavated, it was assumed that SWMU S-28 was taken out of service before the pit was used.

An aerial photograph taken on September 30, 1982 shows objects in the southern end of the pit, which may have been drums. Inspection of an aerial photograph taken on March 17, 1983 showed the area to be backfilled. Therefore, it appears that the excavation was backfilled sometime between September 30, 1982 and March 17, 1983. Whether or not any drums were in fact present when the 1982 photograph was taken and, if so, whether they were buried was not known.

In December 1992, due to contradictions in the RFA as to the correct location of S-28, representatives of the New York State Department of Environmental Conservation (NYSDEC) and Dames & Moore, met at the site and reviewed aerial photographs to determine the field location of SWMU S-28. In January 1993, an area trending northwest/southeast, southeast of S-13, was excavated to a maximum depth of 12 feet – 15 feet below grade (bg). No drums, evidence of drums, or discolored soils were observed, therefore, no soil samples were collected for analysis.

Following USEPA comments (1994), and further review of September 30, 1982 aerial photographs, SWMU S-28 appeared to be located incorrectly on existing site maps. On July 9, 2001, URS representatives met with NYSDEC and BSC personnel to accurately determine SWMU S-28's location. Following this meeting, S-28 was determined to lie directly south of SWMU S-13 (Figure 1). Additional subsequent trenching was conducted in the newly positioned location for SWMU S-28 in July 2001. The results of this subsequent trenching investigation are presented in Section 2.0.

Historical documents obtained from regulatory agencies, including the United States Army Corps of Engineers (US Army Corp) show dredge spoils were deposited off the BSC Lackawanna facility shoreline from at least 1937 to 1948. These spoils underlie a significant portion of the Slag Fill Area (SFA), including the area underlying SWMU S-28. The potential impact of these dredge spoils to groundwater beneath the site, especially in the sand unit in the SFA is further assessed in the RFI.

On February 20, 1996, BSC filed a declaration in the Eric County, N.Y. Clerk's office limiting future use of the property around and including SWMU S-28. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevents the installation and operation of extraction or water wells for purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants and Restrictions is attached as Attachment B.

An inspection of the SWMU, as presently configured, was conducted by URS Corporation (URS) in July 2001. The URS inspection found the site as described in Sections 1.1 and 4.0. The field notes for the 2001 SWMU inspection is available and provided in Appendix A.

2.0 SAMPLING AND ANALYSIS

As part of the Supplemental SWMU Investigation (BSC 2000), soil samples were collected in July 2001. All sampling was conducted in accordance with the *Supplemental SWMU Investigation Work Plan* (BSC 2000). A complete list of the site-specific compounds targeted for analysis in the site investigations is provided in Table 1. Data qualifiers are provided on the page following Table 1. Laboratory analytical reports are provided in Section II of the RFI.

During this investigation, SWMU S-28 was excavated by a series of five trenches spaced 25 feet apart for a total area of approximately 100 feet x 80 feet. The maximum depth of excavation was 16 feet bg and was limited by the reach of the excavator and the density of the slag material. These locations, shown in Figure 1, were field located with the approval of a NYSDEC representative and were positioned to fully assess the area identified in the historical 1982 aerial photograph as being the probable location of SWMU S-28. Soil samples were field screened with a photoionization detector (PID) during excavation activities. PID readings above background levels were noted in trench #4 in a 40 foot lateral layer, 6 to 10 feet bg. A soil sample was collected from this interval for laboratory analysis. A "naphthalene" type of odor was noted during excavation at trenches #3, #4, and #5.

Subsurface materials consisted mostly of black/gray slag fill (consisting of medium to fine sands and gravels and cobble size material). Pieces of timber, steel cable, brick, concrete, rubber hosing, plastic bags and cloth material were observed in trenches #2, #3, #4 and #5. A section of bluish/gray colored fine to medium sand and gravel material was observed in trenches #3, #4 and #5. The material was encountered just below grade level (approximately 2 feet) and dipped between 30^0 and 45^0 toward the south (with the steepest angle in trench #4 and the gentlest angle in trench #5). Excavation continued in all three trenches to determine the lateral and vertical extent of the material. The vertical extent of this material was determined in trenches #4 and #5 while the thickness of the material decreased with depth, with a maximum thickness of approximately 1 to 2 feet. However, in trench #3, the vertical extent of the material was not determined and it appeared to continue beyond 16 feet bg and up to 73 feet laterally along the trench. Test pit logs are included in Appendix B.

There are no downgradient or upgradient monitoring wells for SWMU S-28. Two wells (MWN-36A and MWN-35A) were installed in 2000 south, and southeast, respectively of S-28. These wells were completed upgradient and downgradient of nearby SWMU S-15. They are a considerable distance from (i.e. approximately 160 feet southeast for MWN-36A), and cross-gradient to S-28 and, therefore, are not considered applicable to this waste management unit. However, SWMU S-28 is located within the Zone 4 groundwater area and potential exposure is further addressed in the Tier 1 Human Health Risk Assessment.

2.1 Soil Samples

Soil samples were collected from SWMU S-28 during excavation activities in July 2001. On July 17 and 18, 2001, two grab soil samples were collected from SWMU S-28 for analysis. Sample locations are shown on Figure 1. The soil sample from trench #4 (S-28-TP-4) was described as bluish/grey, fine to medium sand with some pebble size gravel (slag), little silt. This sample was collected at an approximate depth of 6 feet bg for purposes of determining the composition of the "blue" material. This sample location exhibited the highest PID reading. The sample from trench #5 (S-28-TP-5-Slag), was described as dark brown/black, fine sand and gravel (slag), trace silt. This sample was collected at an approximate depth of 8 feet bg, below the bluish/gray soil, also observed in trench #5, to determine if the constituents within the "blue" matrix had leached into the material below. Field sampling records are provided in Appendix C.

Two soil samples (S-28-TP-4 and S-28-TP-5 Slag) were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and cyanide. Analyses included: total constituent analysis of the solid-phase samples, sample processing by the Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP), and analysis of the resulting extracts for VOCs, SVOCs, metals, and cyanide. In addition, analysis was conducted for PCBs, total organic carbon (TOC) and total organic halogens (TOX). Data validation qualifiers are listed with the results on the tables.

2.1.1 TCLP Results

When compared to regulatory levels listed in 40 CFR Part 261, the TCLP extraction concentrations do not exceed the toxicity characteristic criteria. Table 2 summarizes analytes detected in the TCLP analysis.

No VOCs were detected in the TCLP extraction analysis. Two SVOCs were detected above the detection limits in sample S-28-TP-4, however, none were detected in S-28-TP-5 Slag. The SVOC concentrations were 0.059 milligrams per liter (mg/L) for naphthalene and 0.18 mg/L for bis(2-ethylhexyl)phthalate. A total of seven metals were detected between the two samples. Arsenic, barium, calcium, and magnesium were detected in both samples. In addition antimony was detected in S-28-TP-4 and chromium and potassium were detected in S-28-TP-5 Slag. Concentrations ranged from 0.025 mg/L for antimony to 2,100 mg/L for calcium (S-28-TP-4).

2.1.2 Total Constituent Results

One VOC (toluene) was detected in both S-28-TP-4 and S-28-TP-5 Slag. Nine SVOCs were detected in S-28-TP-4. The concentrations of SVOCs ranged from 120 micrograms per kilogram (µg/kg) for acenaphthylene to 4,300 µg/kg for naphthalene. Similarly, eight SVOCs were detected in S-28-TP-5 Slag. The concentrations ranged from 350 µg/kg for anthracene to 2,800 µg/kg for fluoranthene. The same compounds were detected in both samples with the exception of acenaphthylene, which was not detected in S-28-TP-5 Slag. The concentrations of SVOCs in each sample were generally similar.

Eleven metals were detected in both S-28-TP-4 and S-28-TP-5 Slag samples. The same metals were detected in both samples, however, the metals concentrations between the two samples were not as consistent as the SVOC concentrations. The concentrations ranged from 0.033 milligrams per kilogram (mg/kg) of mercury to 176,000 mg/kg of calcium (both from S-28-TP-4). Cyanide was detected in both samples at a concentration of 5.7 mg/kg in S-28-TP-4 and 12.6 mg/kg in S-28-TP-5 Slag. Detected analytical results are presented in Table 3.

2.1.3 SPLP Results

SPLP analysis was conducted to more closely mimic the effect of compounds leaching from SWMU material due to rainwater infiltration. The SPLP results help evaluate what compounds can potentially leach from the waste piles into the subsurface. The analysis was performed in accordance with the USEPA's SW846 Method 1312 protocols.

No VOCs were detected in either soil sample. One SVOC was detected in S-28-TP-4 and four SVOCs were detected in S-28-TP-5 Slag. Naphthalene was detected at a concentration of 0.024 mg/L in S-28-TP-4. S-28-TP-5 Slag SVOC concentrations ranged from 0.0011 mg/L for fluoranthene to 0.0099 mg/L for bis(2-ethylhexyl)phthalate.

Five metals were detected in each of the two soil samples and ranged in concentrations from 0.004 mg/L for chromium to 818 mg/L for calcium (both from sample S-28-TP-4).

2.1.4 Other Analytical Parameters

Additionally, leachable chloride and sulfate were detected in both soil samples. Total organic halogens and total recoverable phenolics were not detected in either sample. Detectable concentrations of PCBs (Aroclor 1260 at 1,300 µg/kg) were found in sample S-28-TP-5 Slag.

2.2 Summary of Analytical Results

TCLP extraction analysis indicates that the material in SWMU S-28 does not meet TCLP criteria.

Total Constituent analysis of the SWMU materials showed several SVOCS and metals to be present. SPLP analysis also indicated several SVOCs and metals detected. However, the number of compounds detected by SPLP analysis was less than the number and concentrations of compounds detected by totals analysis.

Of the four SVOCs detected by SPLP analysis, three of those compounds were also detected in the totals analysis. With the exception of naphthalene, the SVOC concentrations detected by SPLP extraction were higher in S-28-TP-5 Slag than S-28-TP-4. Additionally, there were a greater number of SVOC detections in S-28-TP-5 Slag sample.

Of the eleven metals detected in the Total Constituent analysis, six metals were detected by SPLP analysis. Of the metals detected, the concentrations of barium, calcium, and sodium were greater in the S-28-TP-4 sample. The chromium concentration was greater in S-28-TP-5 Slag. Cyanide and leachable chloride concentrations were greater in the S-28-TP-4 sample..

Although dissimilar in physical appearance (S-28-TP-4 was bluish gray colored fine to medium sand and gravel while S-28-TP-5 Slag was a dark brown sand and gravel), concentrations of total VOCs (one detection) and SVOCs (nine detections) were similar between S-28-TP-4 and S-28-TP-5 Slag samples. The only exception was the SVOCs, naphthalene, which was detected at a much higher concentration in the bluish material than in the underlying slag material. Eleven metals were detected in both samples. Concentrations of several metals were higher in S-28-TP-4, with the exception of chromium, lead, magnesium, mercury, nickel and silver which were higher in S-28-TP-5 Slag.

No groundwater monitoring wells are located upgradient or downgradient of SWMU S-28. Therefore, an evaluation of potential impact to the groundwater from SWMU S-28 was not included in this SWMU assessment. However, further evaluation of the groundwater condition within all of Zone 4 (which includes SWMU S-28), as well as analytes detected in the soil within SWMU S-28 is provided in the Tier 1 Human Health Risk Assessment in Section 3.0.

3.0 RISK ASSESSMENT

A human health risk assessment, as described in the *Human Health Risk Assessment Work Plan* (BSC 1996), was conducted for SWMU S-28, Drum Landfill. SWMU S-28 was reportedly created as a waste material disposal landfill but its use as a disposal site has never been confirmed. The location of SWMU S-28 was subsequently filled with slag material. The results of the Tier 1 Human Health Risk Assessment (HHRA) are presented here and are organized into the following sections: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization and Uncertainty Analysis. The major components of this HHRA have previously been presented in Human Health Risk Assessment Report, Part IV of this RFI Report. Therefore, the following portions provide summary overviews of previously presented information. This section, therefore, serves as a summary report, bringing together all associated and related work from previous risk assessment deliverables, and providing the conclusions of the SWMU-specific risk assessment.

3.1 Data Evaluation

A list of 96 constituents of potential interest (COPIs) was developed for the BSC Lackawanna site based on USEPA and industry studies (BSC 1998). The list contains hazardous constituents that could be present in the waste streams as a result of integrated iron and steel plant operations, such as those historically conducted at the Lackawanna facility. Human Health Risk Assessment ID No. 1 (BSC 1998) established the chemicals of potential concern (COPCs) for each SWMU at the Lackawanna Facility. The COPCs were determined by sequentially applying the following criteria to each COPI on a medium by medium basis for each SWMU and watercourse: 1) the chemical was detected in at least 5% of the samples, 2) the chemical was detected in at least one sample at a level above background (*i.e.*, the maximum concentration was above background; for chemicals in surficial SWMU material only), and 3) the chemical was positively detected in at least one sample at a level above applicable screening criteria [*i.e.*, the maximum concentration was greater than the screening criteria: USEPA Region III Risk Based Concentrations (RBCs), USEPA Soil Screening Levels (SSLs), or NYSDEC Ambient Water Quality Standards and Guidance values]. In accordance with ID No. 1, a background comparison was not made for the subsurface SWMU material in this report.

The sampling data for SWMU S-28 (as presented in Section 2.0 of this report) were evaluated in order to identify the site-related COPCs for the SWMU. Groundwater COPCs for the Lackawanna site were originally determined in ID No. 1, however, as some screening criteria have been revised since ID No. 1 was submitted, and because new samples have been collected, this screening process was revised and is presented in Tables 4 and 5. Table 4 presents the screening of the subsurface SWMU material and Table 5 presents the screening of groundwater. As subsurface SWMU samples have now been collected (*i.e.*, since ID Nos. 1 and 2 were submitted), the screening process is presented for the first time in this HHRA. The methods used to screen are identical to those described in ID No. 1, with updated screening criteria, as appropriate. The screening process for subsurface SWMU material is presented in Table 4. Because only subsurface material samples were obtained for SWMU S-28, COPCs and representative concentrations in subsurface material were also used to represent surface material.

In SWMU material, two semivolatile organic chemicals (benzo(a)anthracene, benzo(a)pyrene), and two inorganic (arsenic, chromium) chemicals were identified as COPCs (Table 4). SWMU S-28 is located in the Zone 4 groundwater area, for which fourteen volatile organic and volatile semivolatile organic chemicals were identified as COPCs. Representative concentrations were then determined for each COPC. For COPCs with data set sample sizes of ten or greater, the 95% upper confidence limit of the mean (95% UCL) was calculated and used as the representative concentration for that COPC. For COPCs with sample sizes of less than ten, the maximum concentration was used. Two samples were collected for subsurface material constituents in SWMU S-28, therefore, maximum concentrations were used. As all of the COPCs data sets in Zone 4 groundwater have at least 10 samples, the 95% UCL was used as the representative concentration for each of the groundwater COPCs. The representative concentrations for the COPCs in this HHRA are presented in Table 6.

3.2 <u>Exposure Assessment</u>

In accordance with ID No. 2, the exposure assessment conducted for SWMU S-28 included a review of current and future human receptor scenarios and potential exposure pathways, as related to COPCs. In general, exposure pathways by which a human receptor could come into contact with SWMU material are defined by four components (USEPA 1989):

- A source and mechanism of constituent release to the environment,
- An environmental transport mechanism,
- A point of potential human contact with the affected medium, and
- A route of entry into humans.

If any one of these components is missing, the pathway is considered incomplete and therefore does not contribute to receptor exposure.

Part IV of this RFI report and HHRA ID No. 2 (BSC 1999) presented the current and future human receptor scenarios and potentially complete exposure pathways for each of the SWMUs originally identified for quantitative risk assessment at the Lackawanna Facility. For SWMU S-28, the potential receptor scenarios were determined in accordance with the methodology within ID No. 2. These include a current commercial/industrial worker, a future commercial/industrial worker, a future construction worker, a future utility/maintenance worker, a trespasser, a future marina worker, a future greenway user, a future fenceline resident, and a present fenceline resident. Potentially complete exposure pathways were also established for each receptor in accordance with ID No. 2. For the future commercial/industrial workers and the trespasser scenarios, the following pathways were determined to be complete: direct contact (*i.e.*, ingestion or dermal contact) with surface SWMU material, inhalation of airborne particulates from uncovered surface SWMU material, or inhalation of vapors from Zone 4 groundwater. These pathways also apply for the construction worker and the utility/maintenance worker scenarios; however, these workers may additionally be exposed to subsurface SWMU material during potential future digging activities. For the future industrial/commercial worker scenario, inhalation of indoor vapors from groundwater was also evaluated as if there was a building on site. For the current non-BSC commercial/industrial worker, marina worker, greenway user, and future resident scenarios, inhalation of particulates in surficial SWMU material is the only complete exposure pathway evaluated in this SWMU-specific risk assessment. A summary of the potentially exposed receptor scenarios and pathways for SWMU S-28 is provided in Table 7.

3.3 Toxicity Assessment

A toxicity assessment characterizes the relationship between the exposure to a COPC and the frequency of adverse health effects that may result from such an exposure (dose-response). The end result of the dose-response assessment is the determination of human uptake levels that provide an adequate measure of protection to exposed persons for carcinogenic and noncarcinogenic endpoints. The derivation of acceptable levels of exposure (*e.g.*, risk-based screening levels) and the manner in which these levels are used in this HHRA are discussed below.

Tier 1 risk-based screening levels (RBSLs) were calculated and compared to the representative SWMU S-28 COPC concentrations. RBSLs are defined as concentrations of COPCs in media that are not expected to produce any adverse health effects under assumed exposure conditions. Tier 1 RBSLs were developed using information previously defined and described in detail in Part IV and ID No. 2; this information is summarized in this HHRA. The equations used to calculate the RBSLs follow basic USEPA risk assessment principles (USEPA 1989; 1996). Conservative exposure parameters, as defined by the ASTM Standard (ASTM 1995) and USEPA guidance (USEPA 1989, 1991a, and 1991b), and USEPA toxicity criteria (USEPA 1997; 2000a), were input into these equations to develop the RBSLs. As some of the toxicity criteria may have been revised by the USEPA since originally presented in ID No. 1, they are presented in Table 8 of this HHRA. The above information was used to calculate Tier 1 RBSLs for COPCs in SWMU material and groundwater, for each of the nine receptor scenarios.

Certain items should be discussed in reference to the RBSL calculations. First, the future commercial/industrial worker RBSL (0.94 mg/kg) that was calculated for direct contact with arsenic is below the arsenic background level established the site (12 mg/kg). As the background level was deemed an appropriate screening value in a previous step of the HHRA, it was used as the default RBSL in lieu of the future commercial/industrial worker scenario RBSL.

Also, in groundwater, some of the RBSLs calculated were greater than the chemicals' solubility in water. This indicates that, based on the predicted amount of chemical volatilization, pure product in the groundwater would not pose an inhalation health threat from these chemicals. In lieu of RBSLs, the solubility limits of these chemicals are indicated in Table 9. Also, some of the RBSLs for

COPCs in SWMU material were determined to be health protective at levels that are greater than 1,000,000 parts per million (mg/kg); such cases are noted by the following indicator ">1,000,000" in Table 9.

A comparison of the representative COPC concentrations to RBSLs for each of the receptor scenarios is presented in Table 9. This comparison provides a preliminary screening of potential risk to the specific receptor populations and exposure pathways identified for this SWMU. For the future commercial/industrial worker scenario, representative concentrations of arsenic, chromium, and benzo(a)pyrene in SWMU material exceed their respective direct contact RBSLs. As discussed below, the arsenic RBSL (0.9) defaulted to the background concentration (12). For the future construction worker scenario, the arsenic concentration exceeded the direct contact RBSL. For all other scenarios, chemicals and pathways, the representative concentrations are below the respective RBSLs and therefore, are not evaluated further.

In accordance with Part IV, those COPCs that do not exceed the Tier 1 RBSLs are not evaluated further. For those COPCs that exceed Tier 1 RBSLs, the risk to human health is evaluated further using a Tier 1 HHRA.

3.4 <u>Risk Characterization</u>

Risk characterization involves the estimation of the magnitude of potential adverse health effects of the COPCs, and summarizing the nature of the health impact to the defined receptor populations. It combines the results of the toxicity and exposure assessments to provide numerical estimates of health risk.

In accordance with Part IV, those COPCs that exceeded an RBSL were further evaluated in the Risk Characterization. The Risk Characterization, or Tier 1 HHRA, provides an estimate of risk and hazard based on a comparison of the RBSL (*i.e.*, health-protective levels) to the COPC concentrations (*i.e.*, site-specific levels). Specifically, for those COPCs that exceed an RBSL, a screening-level hazard index (SLHI) was calculated to evaluate noncarcinogenic health effects, and a total screening-level cancer risk ($SLCR_{total}$) was calculated to evaluate carcinogenic effects. SLHI and $SLCR_{total}$ methodology are presented in the Work Plan (BSC, 1997). The Tier 1 HHRA results are presented in Table 10.

3.5 Noncarcinogenic Hazards

The noncancer hazards were assessed in this HHRA using a hazard quotient approach (USEPA 1989). For each COPC, the noncarcinogenic RBSL was compared to the COPC's representative concentration to determine the screening level hazard quotient (SLHQ) for that chemical. The equation is as follows:

$$SLHQ = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}}$$

SLHQs for each chemical that exceed RBSL are summed to create a total Screening Level Hazard Index ($SLHI_{total}$) for each pathway. The smaller the SLHQ/SLHI, the greater the degree of protection for that pathway. Based on USEPA methodology (USEPA 1989) and as discussed in the Part IV, if the SLHI is less than 1, the risks are considered to be negligible. Those $SLHI_{total}$s that exceed 1 were further evaluated by developing target organ-specific SLHIs. This process is appropriate as only certain chemicals affect similar biological target endpoints, and it is only relevant to quantify the additive effects of such chemicals. This process and results are illustrated in Table 10.

For the future commercial/industrial worker scenario, the SLHI for direct contact with surficial material (and $SLHI_{total}$) is 1.7 attributable solely to chromium.

3.6 Carcinogenic Risk

In a human health risk assessment, carcinogenic health risks are defined in terms of the probability of an individual developing cancer over a lifetime as the result of exposure to a given chemical at a given concentration (USEPA 1989). The incremental probability of developing cancer over a lifetime (*i.e.*, the theoretical excess lifetime cancer risk) is the additional risk above and beyond the cancer risk an individual would face in the absence of the exposures characterized in this risk assessment. In this Tier 1 HHRA, cancer risk was evaluated based on a target risk level of 1×10^{-6}

according to the following equation:

$$SLCR = \frac{\text{Representative concentration}_{COPC/medium}}{RBSL_{COPC/medium/receptor/pathway}} \, x \text{ Target Risk Level}$$

Cancer risks are summed regardless of the differences in target organ, weight-of-evidence for human carcinogenicity, or potential chemical interactions (*e.g.*, antagonistic or synergistic effects). This approach is consistent with USEPA's current approach to carcinogenic effects, which is to assume effects are additive unless adequate information to the contrary is available (USEPA 1989). Based on USEPA methodology (USEPA 1989) and as discussed in Part IV, if the total screening level cancer risk ($SLCR_{total}$) for each receptor/pathway is less than 1 x 10^{-4}, the risks are considered to be negligible.

The $SLCR_{total}$ for the future commercial/industrial worker scenario is 4 x 10^{-5}, attributable to direct contact with arsenic and benzo(a)pyrene in surficial SWMU material. The $SLCR_{total}$ for the future construction worker scenario is 2 x 10^{-6}, attributable to direct contact with arsenic in surficial SWMU material. These SLCRs are all below the acceptable risk benchmark of 1 x 10^{-4}.

3.7 <u>Conclusions</u>

The results of the Tier 1 HHRA are that, for the future commercial/industrial worker scenario, the level of chromium in subsurface SWMU material exceeds the noncarcinogenic RBSL, and produces a calculated hazard index that is greater than the Tier 1 noncarcinogenic benchmark of 1.0.

Based on these results and in accordance with the work plan, further evaluation will be completed during the Corrective Measures Study (CMS) and could include a Tier 2 assessment or an evaluation of corrective measures. It is relevant to note that the chromium in the HHRA was evaluated as hexavalent chromium. This and other uncertainties inherent in the conclusions are presented in the following Uncertainty Analysis.

3.8 Uncertainty Analysis

There are multiple sources of uncertainty that may be identified for any risk assessment. These include, among others, uncertainty associated with the toxicity criteria used to derive dose-response factors, uncertainties associated with exposure parameters used in the exposure assessment, and uncertainties associated with combining exposure parameters and toxicity criteria to characterize risk.

In the development of any health assessment, some level of uncertainty is introduced each time an assumption is relied upon to describe a dynamic parameter. Some assumptions have a significant scientific basis while others do not, which may result in the selection and use of conservative, default exposure parameters in the exposure assessment. The selection of multiple conservative assumptions in the exposure assessment generally results in an overestimation of potential health risks associated with exposure to specific chemical constituents. The primary areas of uncertainty for this risk assessment are qualitatively discussed below.

3.8.1 Site Sampling and Representative Concentrations

SWMU samples were selected in an attempt to identify the highest concentrations of chemicals at the site. Sample biasing was accomplished based on visual observations and photoionization detector readings. Thus, the sampling activities are thought to have characterized the most highly impacted areas of the SWMU and not an average. This is conservative, as a potential receptor is not expected to remain on, or inhale particulates from, one portion of the SWMU for his or her entire exposure duration. Therefore, it is believed that the maximum concentrations used in this HHRA are likely to represent the true maximum site concentrations and overstate the average concentration.

It should also be noted that for all COPCs in subsurface SWMU material, the maximum concentration was used as the representative concentration in this HHRA. This was because only two samples were collected; not enough to calculate a 95% UCL. The representative concentrations were used to compare to the RBSLs calculated for this HHRA, and ultimately determine the chemicals of interest in this HHRA. Use of the maximum concentrations of the biased sampling is a very conservative methodology utilized in this HHRA.

3.8.2 Chromium vs. Hexavalent Chromium [Cr(VI)]

In both the screening process and the RBSL development, chromium at this SWMU is assumed to be in the hexavalent form. This was to err on the side of conservatism, as Cr (VI) is the most toxic form of chromium, and the only carcinogenic form. Both the representative concentration and the maximum concentration of chromium is 641 mg/kg. This exceeds the Region III RBC for Cr (VI) of 230 mg/kg and the calculated Cr (VI) RBSL of 373 mg/kg. However, if it were shown that the chromium was not hexavalent chromium, this chemical would not have been selected as a COPC (Table 4), as the residential RBC for trivalent chromium is 12,000 mg/kg.

3.8.3 COPC Selection Process

The COPCs evaluated for this SWMU were identified in the Human Health Risk Assessment Interim Deliverable (ID) No. 1 (BSC 1998). These chemicals were selected in part because of their representative concentrations exceeded Region III RBCs (USEPA 2000b) for residential scenarios. Since no residential exposures are realistic for any of the on-site scenarios, some chemicals have been retained as COPCs, that are not likely to pose a potential threat to most of the human receptors, evaluated here.

3.8.4 Use of Subsurface Data to Represent Surface Data

As mentioned previously, surface data was not collected for this SWMU; therefore, subsurface data was used as surrogate data for surface material. Using the data from the biased sampling of the subsurface SWMU material in S-28 as representative of the surface data is a conservative approach.

3.8.5 Exposure Parameters

Several conservative default exposure parameters (*e.g.*, inhalation rates, exposure frequency, and exposure duration) were incorporated into the exposure assessment to define general population behavior. For example, for the industrial/commercial worker scenarios, default exposure parameters are intended to be conservative and representative of an individual who is consistently present at the site 24 hours a day, 250 days a year, in the area of highest concentration. It is more likely that the exposure of an industrial worker to a *particular SWMU* (*i.e.*, SWMU material) on the Lackawanna site is limited to an average of only a few hours a day, 2 weeks year. Most parameters incorporated into the exposure assessment to define the receptor scenarios are conservative values and used to define a worst-case population behavior. The net effect of using multiple conservative exposure assumptions is the overestimation of potential health risks.

Additionally, for a receptor population such as an industrial worker or a resident (*i.e.* where exposure duration is greater than 250 days/year), exposure frequency typically is corrected in site-specific health risk assessments for the fraction of the year when outdoor exposure to soil will be limited due to severe weather conditions such as snow, ice, rain and freezing temperatures (USEPA 1989). This factor is called a meteorological factor. Because of the geographical location of the Lackawanna site, a correction factor for weather conditions would be reasonable. In this Tier 1 human health risk assessment, exposure did not exclude days when the temperature is less than 32°F and not when there is snow cover or the ground was wet from other forms of precipitation. For this SWMU, the Tier 1 RBSLs were exceeded for the future commercial/industrial worker scenarios. Thus, applying a more realistic exposure frequency and a meteorological factor would result in higher RBSLs.

3.8.6 <u>Toxicity Assessment</u>

Noncarcinogenic Criteria- Toxicity information for many of the COPCs is limited for humans. Consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty will be associated with the calculated toxicity values. The USEPA derives reference concentrations (RfC; inhalation exposures) and reference doses (oral exposures) for chemicals using an uncertainty factor (UF) approach. The UF for arsenic, for instance, is 3. This was applied to account for both the lack of data to preclude reproductive toxicity as a critical effect and to account for some uncertainty in whether the NOAEL of the critical study accounts for all sensitive individuals. The UF for chromium, however, is 300. The uncertainty factor of 300 represents two 10-fold decreases in dose to account for both the expected interhuman and interspecies variability in the toxicity of the chemical in lieu of specific data, and an additional factor of 3 to compensate for the less-than-lifetime exposure duration of the principal study.

Carcinogenic Criteria- USEPA cancer SFs are developed using variations of the Linear Multistage Model (LMS) for carcinogenicity. The LMS is highly conservative as it assumes linearity between dose and effect to zero dose assuming no threshold for carcinogenicity. However, the human body has mechanisms to detoxify most chemicals particularly at low doses, and therefore many scientists believe that most, if not all carcinogens only cause cancer above a "threshold dose."

The carcinogenic COPCs evaluated for this SWMU include arsenic. The inhalation slope factor for arsenic is based on human data from occupational exposure studies, and thus an extrapolation from animal data is not necessary, thereby reducing the some uncertainty in the slope factor. However, there is significant uncertainty associated with the low dose extrapolation (environmental exposures are relevant in the low dose range) used to generate the slope factor. The USEPA has used its default linear model to estimate risks in the low dose range citing lack of carcinogenic mode of action information. Thus, should this information become available, the low dose carcinogenic risks for arsenic may be evaluated differently.

Additionally, the derivation of the slope factor for benzo(a)pyrene has some uncertainty. The oral SF for benzo(a)pyrene (7.3 $(mg/kg\text{-}day)^{-1}$) is the geometric mean of four slope factors derived from two rodent feeding studies: Neal and Rigdon (1967), a mouse study and Brune *et al.* (1981), a rat study. Three of the four values employ the data from the Neal and Rigdon (1967) study. The fourth cancer slope factor estimate was made using the linearized multistage model to calculate the upper 95% confidence interval on the slope in the low dose region using the data of Brune et al. (1981). The Neal and Rigdon (1967) study suffers from several study design flaws including dosing regimens and length of observation periods. Thus, in three of its four cancer slope factor estimates, U.S. EPA mathematically manipulated data from a poor animal bioassay that did not conform to the standards of modern toxicology to derive the values. The mouse cancer slope factor was translated into a human cancer slope factor but there are no studies showing that ingestion of PAHs can cause cancer in humans. Additionally, this SF was extrapolated and used for six other carcinogenic PAHs.

Absence of Inhalation Toxicity Criteria - Although toxicity information is generally available for the most significant chemicals and exposure routes in this HHRA, there were some volatile COPCs in this HHRA for which no inhalation toxicity criteria (RfDs or cancer slope factors) exist. In the absence of data, either the oral RfD or oral SF was used to evaluate inhalation exposures. The letter "R" on Table 5 notes these instances. This extrapolation assumes that the chemical is equitoxic by both routes. It is more conservative to evaluate these chemicals for inhalation exposures than to not evaluate them at all. Thus, this method potentially overestimates inhalation risks for COPCs evaluated as such. This uncertainty is not applicable to the inhalation RfCs or slope factors for the COPCs which exceeded their Tier 1 RBSLs at the this SWMU.

3.8.7 Risk Characterization

Uncertainties in the risk characterization portion of the risk assessment for the site are a combination of the uncertainties associated with both the dose-response assessment and the exposure assessment. As discussed above, the assumptions and parameters used for both the dose response and exposure assessments are extremely conservative. In addition, since the toxicity criteria and exposure parameters are combined in the risk characterization, the conservatism is compounded.

3.8.8 Uncertainty Analysis Summary

This Tier 1 HHRA includes uncertainties and conservative assumptions that, in general, effectively combine to overestimate the potential current and future exposures. The major sources of uncertainty contributing to the conservatisms in this HHRA are summarized below:

- Treating all chromium as if it were hexavalent
- Use of maximum concentrations as representative concentrations
- Use of subsurface SWMU material as surrogate data for surface SWMU material
- Compounding effect multiple conservative exposure parameters
- No meteorological correction factor
- Confidence in toxicity criteria

The net effect of the uncertainties of this HHRA is the generation of risk and hazard estimates that probably far exceed any true exposure conditions that currently exist or which could possibly exist in the future.

4.0 CONTAINMENT

SWMU S-28 is a relatively flat, moderately vegetated area. There is no engineering containment associated with the SWMU. However, a drainage ditch associated with S-13 is located immediately to the north and west of S-28 and a slag berm associated with SWMU S-15 is located to the south. Surface water runoff would drain either toward the drainage ditches or remained contained within the SWMU S-28 area. In either case, surface water would eventually evaporate or infiltrate into the surface. A site inspection conducted by URS in 2001 revealed minor evidence of surface water runoff from SWMU S-28.

5.0 CONCLUSIONS

Based on the data collected and evaluated during the investigation, BSC concludes the following:

- TCLP results from soil samples obtained from SWMU S-28 demonstrate that the material in the SWMU does not meet the TCLP criteria.

- Total constituent analysis of the SWMU materials showed several SVOCS and metals to be present. SPLP analysis also indicated several SVOCs and metals detected. However, the number of compounds detected by SPLP analysis was less than the number of compounds detected by totals analysis.

- The results of the Tier 1 HHRA are that, for the future commercial/industrial worker scenario, the level of chromium in subsurface SWMU material exceeds the non-carcinogenic RBSL, and produces a calculated hazard index that is greater than the Tier 1 non-carcinogenic benchmark of 1.0.

Based on these results and in accordance with the Work Plan, further evaluation will be completed during the CMS and may include a Tier 2 assessment or an evaluation of corrective measures.

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SWMU ASSESSMENT REPORT
DRUM LANDFILL
(SWMU S-29)

BETHLEHEM STEEL CORPORATION
LACKAWANNA, NEW YORK

SEPTEMBER 2004

BETHLEHEM STEEL CORPORATION
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FIGURES
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Figure 1 Location of SWMU S-29

Figure 2 Location of Test Trench in SWMU S-29

APPENDICES

Appendix A SWMU Inspection Reports

Appendix B Test Pit Log and Field Notes

ATTACHMENTS

Attachment A USEPA Comments

Attachment B Deed Restriction

1.0 INTRODUCTION

This report documents the results of an environmental assessment of the Drum Landfill at Bethlehem Steel Corporation's (BSC's) Lackawanna, New York facility. The Drum Landfill was identified by the United States Environmental Protection Agency (USEPA) as Solid Waste Management Unit (SWMU)] S-29 in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (USEPA 1988) for the facility as an excavation adjacent to the southern end of Asbestos Landfill L (SWMU S-12). The unit was designated as a SWMU because the USEPA reported that it appeared as if drums were present in the unit based on review of a September 1982 aerial photograph. It was further mentioned that the excavation was identified as having been seen in 1978 but absent in March 17, 1983 aerial photographs. Because waste may have been backfilled in the excavation, the unit was designated a SWMU. BSC has no evidence indicating that this area was used for drum disposal. The USEPA has required that a RCRA Facility Investigation (RFI) of this and other SWMUs at the BSC facility be completed in accordance with the Administrative Order on Consent (AOC) signed by BSC and USEPA in 1990 (USEPA 1990). The RFI has been conducted in phases (Phases I, IIA, IIB, IIC, and III), and included field work consisting of the collection and analysis of environmental samples from SWMUs and other areas throughout the property. This report evaluates SWMU data available to BSC as of November 2001.

A preliminary SWMU assessment was completed and submitted to the USEPA on January 5, 1993. Attachment A provides USEPA and New York Department of Environmental Conservation (NYSDEC) comments regarding the Preliminary SWMU Assessment. This assessment report provides additional information to further address the USEPA's comments.

1.1 Description

SWMU S-29 is located in the northwestern portion of the Slag Fill Area of the BSC Lackawanna facility, immediately south of the Asbestos Landfill L (SWMU S-12) (Figure 1 and Figure 2). This SWMU consists of a backfilled area whose approximate dimensions are 65 feet long, 40 feet wide, and 7 to 9 feet deep. The SWMU S-29 area was identifiable on the ground as an obvious backfilled area within a swale located between two elevated railroad tracks.

The swale is approximately 40 feet wide at the top, 7 feet deep and several hundred feet long with the side slopes having a ratio of approximately 1:1. The elevated ridge to the east of the swale contained a former rail bed. The proximity of the SWMU S-29 area to SWMU S-12 strongly suggests that the slag backfilled material came from the excavation of the pit that contains SWMU S-12. Miscellaneous iron debris is present within and on the surface of the backfill that lies between SWMU S-29 and SWMU S-12. The swale to the south of the backfilled area is empty (see Figure 2).

An assessment of surface water flow determined that water generally flows west, east, and south from the surface of the SWMU into the swale where it eventually drains into the slag fill. Groundwater is approximately 24 feet from the surface of SWMU S-29.

1.2 History of Use

SWMU S-29 has no specific history of use other than being in an area, which accepted slag and other fill material. It is not associated with the disposal or containment of wastes generated from facility processes. It is, however, located near other SWMUs, such as the Asbestos Landfill L (S-12) and the General Rubble Landfill O (S-15).

On February 20, 1996, BSC filed a declaration in the Erie County Clerk's Office limiting the future use of the property in the Slag Fill Area, including SWMU S-29. Under the deed restriction, future use of the property shall be limited to industrial use only. Industrial use includes manufacturing, assembling, warehousing, and related railroad, port, and shipping activities. The deed restriction also prevents the installation and operation of extraction or water wells for purposes other than environmental remediation use. A copy of the Declaration of Conditions, Covenants, and Restrictions is provided in Attachment B.

Site inspections of the excavation were conducted by Dames & Moore in September 1996 and by URS Corporation in June 2000. Copies of the inspection reports are provided in Appendix A. The June 2000 inspection revealed that the site was in good condition. No evidence of drums or waste was observed.

2.0 FIELD INVESTIGATION

To characterize the material in SWMU S-29 a text trench was excavated in January 1993. The test trenching was conducted in accordance with the Phase IIA Work Plan (BSC 1992). Because of contradictions in the RFA as to the location of SWMU S-29, the final field location for SWMU S-29 was agreed upon by representatives of the New York State Department of Environmental Conservation (NYSDEC) and a previous consultant, Dames & Moore (D&M), after inspecting the appropriate aerial photographs and conducting a site visit. The contradictions in the RFA consisted of the text on page 86 that placed the SWMU adjacent to SWMU S-13 and Figure 10, which showed the SWMU adjacent to SWMU S-12. On January 12, 1993, a test trench was excavated in the backfilled (northern) portion of SWMU S-29 to determine whether drums had been disposed in this area. A D&M engineer oversaw excavation activities. The orientation of the pit and the approximate dimensions are shown in Figure 2.

Excavation was started at the southern end of the backfilled region adjacent to the open swale using a backhoe. The center of the backfilled region was then opened to a width of about 25 feet and a depth of about 7 feet. The backfill material encountered was described as a gray, fine to coarse graded gravel with brown, fine to medium grained silty sand (slag). A test pit log providing a generalized summary of the materials observed during excavation activities and a field sketch is presented in Appendix B. During excavation, a small amount of debris was found consisting of a few sheets of corrugated sheet metal and some lengths of steel cable. The final length of the excavation was approximately 48 feet. It was terminated at its northern end, after encountering miscellaneous iron and steel scrap, which was also stockpiled on the surface. Following completion of the excavation, the test pit was filled with the previously excavated material.

No evidence of drums, odors, or discolored soils was encountered during the test pit excavation. As a result, no samples were collected or analyzed.

3.0 RISK ASSESSMENT

In accordance with the Human Health Risk Assessment Interim Deliverable (ID) No.1 (BSC 1998), SWMU S-29 was eliminated from quantitative analysis. Originally identified in the RFA as a drum landfill, subsequent SWMU investigations have not identified the presence of any drums or evidence of other waste disposal, other than miscellaneous debris. Thus, there are no complete exposure pathways associated with S-29, and further evaluation in a Corrective Measures Study (CMS) is not warranted.

4.0 CONTAINMENT

SWMU S-29 is not a waste disposal unit and, therefore, no containment structures such as liners or covers are present. Because the results of the site investigation did not reveal any evidence of drums or wastes, containment is not a concern. The area around S-29 is an inactive slag fill area. There are no plans for the immediate use of this area.

5.0 CONCLUSION

Based on review of the data, no evidence of past waste disposal was encountered during the investigation of SWMU S-29. No record or other information regarding disposal of wastes in this unit has been found by BSC. Therefore, no further assessment of this unit is required because it is not a source of potential releases of contaminants to the environment.

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ATTACHMENT 7

LISTING OF PREVIOUS SITE OWNERS

The subject Site is on the Slag Fill Area. This is property that was created after 1937 by filling with slag beyond the Lake Erie shoreline. As such, ownership records are provided after 1937 for the subject Site. According to the Real Estate Records, in 1937, Bethlehem Steel Company owned the subject Site. In 1964, Bethlehem Steel Company merged into Bethlehem Steel Corporation. Finally, in 2003 Tecumseh Redevelopment, Inc. purchased the property.

ATTACHMENT 8

LISTING OF PREVIOUS SITE OPERATORS

As was discussed in Attachment 7, the subject Site is on the Slag Fill Area. This is property that was created after 1937 by filling with slag beyond the Lake Erie shoreline. As such, operator records are provided after 1937 for the subject Site. According to the Real Estate Records, in 1937, Bethlehem Steel Company owned and operated the subject Site. In 1964, Bethlehem Steel Company merged into Bethlehem Steel Corporation. Finally, in 2003 Tecumseh Redevelopment, Inc. purchased the property becoming the operators of the Site.

ATTACHMENT 9

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Buffalo, NY 14202

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Phone: (716) 823-0630

Nearby School
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Superintendent Paul Hashem
30 Johnson St.
Lackawanna, NY 14218
Phone: (716) 827-6708

ATTACHMENT 10

DOCUMENT REPOSITORY CONFIRMATION LETTER

TurnKey Environmental Restoration, LLC

April 10, 2006

Ms. Jennifer Hoffman
Buffalo & Erie County Public Library
Lackawanna Public Library Branch
560 Ridge Road
Lackawanna, N.Y. 14218

Re: Steel Winds Brownfields Cleanup Program (BCP) Application
Document Repository Copy

Dear Ms. Hoffman:

Per my previous telephone conversation with Mr. Bordonaro, thank you for agreeing to the Lackawanna Public Library Branch acting as the document repository for the above-referenced site. As requested, all site documents will be labeled "For placement at Lackawanna Public Library Branch" and sent to your attention at the address above.

Please contact us if you have any questions or require additional information

Sincerely,
TurnKey Environmental Restoration, LLC

Nathan T. Munley
Environmental Scientist

0083-002-300

726 Exchange Street, Suite 624 | Buffalo, NY 14210 | phone: (716) 856-0635 | fax: (716) 856-0583

ATTACHMENT 11

ENVIRONMENTAL FACTORS AND HISTORIC LAND USE CONSIDERATIONS

Information related to 'important federal, state or local natural resources, including waterways, wildlife refuges, wetlands, or critical habitats or endangered or threatened species proximate to the site was researched and reported in the "Revised Draft RCRA Facility Investigation Report, Part III: Ecological Risk Assessment" Former Bethlehem Steel Corporation, September 2004. Excerpts from this reference are included in this attachment for inclusion into the BCP Application. The following provides a brief summary of the attachment:

- There are no wetlands on the subject Site.
- The site is "adjacent to a Significant Coastal Fish and Wildlife Habitat, Smokes Creek Shoals". The significance is due to the importance of Smokes Creek Shoals as a walleye spawning area.
- There are no threatened or endangered species, nor important plant habitats listed at the site.

3.0 TIER 1: SCOPING ASSESSMENT

The Tier 1 assessment includes elements of the problem formulation and it defines the scope for the risk assessment, *i.e.*, how SWMU-related chemicals may impact sensitive ecological receptors. This section provides a general site description, habitat evaluation, stressor identification, selection of ROIs, assessment and measurement endpoints selection, and the development of the conceptual site model.

3.1 GENERAL SITE DESCRIPTION

The Former Bethlehem Steel facility is located in Erie County, New York, primarily in the City of Lackawanna, although portions extend into the Town of Hamburg, the Village of Blasdell, and the City of Buffalo (Figure 1-1). The Site encompasses approximately 1,600 acres and is zoned medium-density industrial. It extends a distance of about 2.5 miles from Lake Avenue in the Village of Blasdell on the south to the Buffalo Outer Harbor and the Union Ship Canal on the north, and about one mile from Lake Erie east to New York State Route 5 (Hamburg Turnpike). A small portion of the Site lies to the east of the NY State Route 5. Blasdell Creek forms the southern border, beyond which is a residential area (Woodlawn). Smokes Creek runs through the site from east to west at the approximate midpoint.

The Site was used for iron and steel production from the beginning of the 20th century until the fall of 1983 when the majority of these operations were shut down. Operations within the Lackawanna Coke Division and the Galvanized Products Division ceased in October 2001.

Approximately 440 acres of the Site were created by the placement of fill materials onto the former Lake Erie shoreline to an average of 1,300 feet into the lake. The 440 acres used for the placement of slag fill, which are referred to throughout this RFI report as the Slag Fill Area (SFA), extend along the entire, current western boundary of the site (see Figure 1-2). This filling activity was conducted in an area formerly used as a dumping ground for dredge spoils and other materials by the United States Army Corps of Engineers (ACOE) and others prior to the time that the slag filling operation occurred (see Figure 3-1).

The primary fill material placed in the SFA by BSC was slag from iron and steel production; however, other materials, including construction and demolition debris were placed in this area. Within these 440 acres, discrete and identified areas (SWMUs) were used for the management of waste materials, including sludges from wastewater treatment plants; sludges, dusts, and liquids from iron-making, steel-making, steel-forming, steel-finishing, and coke-making operations; and sediments dredged from Smokes Creek. The SFA has also been the site of oil storage tanks, coal storage piles, and the management areas for various types of materials from Plant operations.

Portions of the SFA have been divided arbitrarily into five zones for purposes of programming future development: Currently, Zone 1 is undergoing slag reclamation with Zones 3 and 5 planned for future reclamation. Specific SWMUs in Zones 2 and 4 were used for waste management areas and will be remediated (Figure 3-2).

In general, the Site is characterized by low topographic relief, with slopes of only a few feet per mile. Within the SFA, slag piles create man-made slopes. South of Smokes Creek, in Zone 1 of the SFA, much of the slag has been reclaimed and removed by Buffalo Crushed Stone, Inc., which has created a roughly level surface approximately seven feet above the lake level. In Zone 2, also south of Smokes Creek, the fill rises to approximately 60 feet above the lake level before dropping off sharply at the lake shore (See Attachment A, Photos 1 and 7). North of Smokes Creek, within SFA Zones 3, 4 and 5, the fill rises from lake level to more than 70 feet in some locations, with the highest mounds toward the north end of the site (Attachment A, Photos 20, 21, 26, and 30).

Although the site has a varied topography, there is little opportunity for precipitation runoff to leave the site via a surface pathway. This was demonstrated through a study conducted by BSC in 1997 to identify potential runoff pathways from site SWMUs to the on-site and off-site watercourses (discussed on a SWMU-by-SWMU basis in Parts V and V1 of this RFI report). The slag fill is generally very porous, and precipitation typically is taken into the slag before substantial runoff occurs. Exceptions include precipitation that falls on the shoreline embankments (*e.g.*, along Lake Erie) that slope towards a water body.

There is a state-regulated wetland area to the northeast of the site, approximately one mile from the site boundary. This nearby offsite wetland appears to be a remnant of a much larger wetland associated with the Buffalo River that most likely existed before industrialization of the area. Part of this wetland lies within the Tifft Farm Nature Preserve operated by the Buffalo Museum of Science (Figure 3-3).

3.2 UPLAND AREAS

The following section provides a habitat characterization and the analytical results from soil sampling conducted within the SWMUs at the BSC Lackawanna property.

3.2.1 Upland Habitat Characterization

Habitat characterization of the Site was conducted through a literature search and onsite observations during ecological surveys conducted in June 1993, July/August 1995, and June 2001. Information from the literature concerning the natural resources of the site vicinity was requested from the U.S. Fish and Wildlife Service and the following NYSDEC entities (Attachment B):

- Natural Heritage Program
- Significant Habitats Program
- Bureau of Fisheries, Lake Erie Unit
- Environmental Disturbance Investigation Unit
- Toxic Substances Monitoring Program.

Information was obtained also from the State University of New York at Buffalo. The type of information obtained from these entities is incorporated into the report text.

3.2.1.1 1993 Survey

An ecological survey of the Site and vicinity (*i.e.*, terrestrial habitat within one-half mile of the site) was performed in May 1993 (Attachment C) by Dames and Moore and included a list of observed fauna and flora within the Site and the one-half mile study radius along with maps depicting significant plant habitat and wetlands; none were observed on the BSC site. Dominant vegetation was mapped specifically for the Site (Attachment C, Map A2). Vegetation consisted of perennials and some shrubs and trees consistent with an early successional landscape [*e.g.*, eastern cottonwoods (*Populus deltoides*)]. Most conspicuous was a large nesting colony of ring-billed gulls (*Larus delawarensis*) observed around the ACOE spoil disposal area off at the north end of the site. Nesting colonies of bank swallows (*Riparia riparia*) and rough-winged swallows (*Stelgidopteryx ruficollis*) were also noted at several locations along the SFA where the slag formed cliffs or steep banks. In 1993, little evidence was observed to indicate frequent use of the terrestrial portion of the site by wildlife.

The 1993 survey made use of the Erie County Waterfront Master Plan (Saratoga Associates, 1991) for information about natural resources in the study area, which included the coastal zone for the entire county. Lists of animals and plants expected to inhabit the study area, in both aquatic and terrestrial environments were also included in this resource. According to the 1991 master plan, and based on on-site observations, there are no wetlands of appreciable size, threatened or endangered species, nor important plant habitats at the BSC site.

The results of the 1993 survey indicated that the majority of the SFA was unvegetated (Figure 3-4) and vegetated areas that did exist were in very early stages of primary succession. The dominant plants of this type are typically hardy and fast growing and have seeds that disperse over a large area. A perennial forb cover or bare ground typified the majority of the areas. The most frequently encountered plants around the SWMUs were goldenrods (*Solidago* spp.), wild carrot (*Daucus carota*), staghorn sumac (*Rhus typhina*), and sapling eastern cottonwood. Trees around the SWMUs provided little cover. The patterns of cover seen around the SWMUs were typical of the SFA in general. Only a few locations, such as SWMU S-4 and a small area on the northwest edge of SWMU S-22, have been undisturbed long enough to develop small woodlots.

3.2.1.2 1995 Survey

In August 1995, observations of the terrestrial habitat within the SWMUs were made by Dames and Moore that included descriptions of the topography, vegetation, and soil along the boundaries of each SWMU, as well as vegetation (or lack thereof), and visual evidence of waste materials on the SWMU's surface. Topographic observations were usually limited to whether the SWMU surface was higher or lower than the surroundings and whether there was a berm around the SWMU. Vegetation was described by estimating vegetative cover for biota and cover such as trees, shrubs, grasses, forbs (herbs other than grasses) (annual and perennial), mosses, and bare ground.

Annual and perennial life histories were assessed for important species using information presented in Fernald (1970) and United States Department of Agriculture Soil Conservation Service (USDA SCS)(1982). Bare ground was included as a cover type because it can be indicative of the ability of soil to support plant growth. Estimates of the height of shrubs and trees were also made. Surface materials were described qualitatively including observational parameters such as color, grain size, thickness, and moisture condition (Table 3-1).

Noting that both physical and chemical stressors may result in vegetation changes, observations were made of signs of physical disturbance and estimates of the length of time since the disturbance. SWMU boundary conditions tended to be similar to surrounding habitat, so descriptions of the vegetation around 26 SWMUs provided the information needed for habitat characterization.

3.2.1.3 Avian Surveys

Avian surveys were conducted by Dames and Moore in June 1993 and July/August 1996 to provide baseline biological information necessary to determine completeness of pathways to avian receptors. The 1993 survey observed species and some behavior; the 1996 survey focused on identifying the avifauna that utilize the Site's aquatic habitat and provided information regarding complete exposure pathways for a more complete evaluation of possible receptor exposure to site-related COPECs. Community descriptions for the 1996 survey were based on Reschke (1990).

The survey technique consisted of traversing the site on foot, pausing frequently to identify visual and auditory contact with birds. The 1996 survey was conducted during the early morning (0500-1000) and evening (1700-2100) hours. Birds seen or heard were identified when possible, and records were maintained for all observations. Extensive open areas and extended sight lines characteristic of the Lackawanna site permitted bird identification over long distances (greater than 200 to 300 feet). The 1993 survey resulted in the identification of 20 species; the 1996 survey observed an additional 21 species.

The avifauna observed in 1996 utilizing the habitat at Smokes and Blasdell Creeks include the omnipresent ring-billed gull, mallard (*Anas platyrhynchos*), great blue heron (*Ardea herodias*), green-backed heron (*Butorides striatus*), spotted sandpiper (*Actitis macularia*), belted kingfisher (*Megaceryle alcyon*), barn swallow *(Hirundo rustica*), and rough-winged swallow. Other species are expected to seasonally utilize the aquatic habitat during migration or overwintering. One great blue heron and one belted kingfisher were repeatedly observed foraging within Smokes Creek, and a green-backed heron was regularly observed foraging in Blasdell Creek.

Characteristic birds seen in the upland areas of the Site include common nighthawk (*Chordeiles minor*), observed in 1996, American robin (*Turdus migratorius*), European starling (*Sturnus vulgaris*), mourning dove (*Zenaida macroura*), American goldfinch (*Carduelis tristis*), killdeer (*Charadrius vociferous*), northern mockingbird (*Mimus polyglottos*), swallows [barn], northern rough-winged, and bank), American crow (*Corvus brachyrhynchos*), and wild turkey (*Meleagris gallopavo*) (Table 3-2).

3.2.1.4 2001 Survey

Fauna and dominant flora were noted during the June 2001 sampling event conducted by AMEC Earth & Environmental (Table 3-2). Based on observations made during the survey, the Site is apparently characterized by greater species diversity than in the past both for animals and vegetation. Small stands of eastern cottonwood [diameter at breast height (dbh) less than 15 inches] were noted, primarily in the western areas of the site, nearer to the lakeshore. Deer (*Odocoileus virginianus*) and rabbits (*Sylvilagus floridanus*) were noted in many SWMUs, either directly or by tracks. One possible explanation is that there were fewer disturbances at the Site that has allowed for the further progression of natural succession.

An avian survey conducted during the 2001 field events encompassed terrestrial and aquatic habitats. Aside from the large breeding colony of ring-billed gulls, killdeer, European starling, bank swallow and rough-winged swallow were also observed nesting onsite. The 2001 avian survey added 12 additional species to the list of birds observed at BSC for a total of 53 species. A complete list of fauna and flora observed during all three surveys is presented in Table 3-2.

Two species of special concern - common nighthawk (1996) and short-eared owl (*Asio flammeus*) (2001) were observed at the site. The NYSDEC defines species of special concern as:

> "... those native species which are not yet recognized as endangered or threatened, but for which documented evidence exists relating to their continued welfare in New York State. The Special Concern category, while existing in DEC rules and regulations, does not in itself provide protection."

While the presence of these species is not of regulatory significance, their occurrence is an indication that the property has some ecological value.

3.2.2 Soil Analytical Results

As part of the RFI process, surface soil samples were collected from various SWMUs at the Site for laboratory analysis. The results are presented in the following sections as part of the site characterization process. Soil samples were collected in 1994, 1995 and June 2001. As part of the 2001 sampling activities, soil samples were collected within Zones 2, 3, 4, and 5 in non-SWMU areas to serve as reference locations for characterization of background concentrations of COPECs in slag. Soils were analyzed for volatile organic compounds (VOCs), semi-volatile

3.2.2.4 Zone 5

Three samples were collected from Zone 5 (not from a specific SWMU) at a depth of zero to six inches. TCE and BEHP were detected in two samples each at concentrations up to 7.5 μg/kg and 61 μg/kg, respectively. Up to ten PAHs were detected at concentrations up to 5700 μg/kg [pyrene (PYR)]. Every metal except antimony and total cyanides were detected (Table 3-4; Attachment D).

3.3 AQUATIC HABITATS

The creation of the SFA at the Site resulted in the reconfiguration of the pre-1900 Lake Erie shoreline and addition of new surface area in what was formerly part of Lake Erie. As noted previously, portions of this area were used as a dumping ground by the ACOE and others (Figure 3-1). The Site is bounded on three sides by water, on the south by Blasdell Creek, on the west by Lake Erie, and on the north by the Buffalo Outer Harbor (also Lake Erie) and the Union Ship Canal. In addition, the SFA is divided into north and south areas by Smokes Creek. The north area also contains three man-made watercourses: the Gateway Metroport Ship Canal, the North Return Water Trench (NRWT), and the South Return Water Trench (SRWT).

3.3.1 Lake Erie

The following sections describe the physical characteristics, habitat characterization and analytical results of surface water and sediment sampling conducted in Lake Erie.

3.3.1.1 Physical Characteristics

The western boundary of the SFA along Lake Erie is approximately 13,000 feet (approximately 2.5 miles) in length compared to a total lake perimeter of 871 miles (GLIN, 2002). In the site vicinity, the lake bottom consists of lacustrine silts and clays (Dames & Moore, 1978). The mean lake elevation for the years 1918 to 1996 was 571.30 feet above mean sea level (msl)

(International Great Lakes Datum [IGLD], 1985) and 573.24 feet above msl (IGLD) in 1997 (ACOE, 1998).

A portion of the northern end of the Site is bordered by the Buffalo Outer Harbor, a part of Lake Erie which has been partially separated from the main water body by a long break wall and includes the ACOE dredge spoils area (Figure 3-1). The harbor provides a link between the Gateway Metroport Ship Canal, the Union Ship Canal, and Lake Erie. The water level in the harbor is essentially the same as in the lake; however, because the harbor is protected by break walls, wind-induced fluctuations tend to be much smaller than those observed in the lake. For navigational purposes, the harbor is maintained at the same approximate depths as the Ship Canal (Dames & Moore, 1993).

3.3.1.2 Habitat Characterization

Benthic invertebrate biomonitoring has been conducted by the USEPA within the Great Lakes at five sampling stations within Lake Erie. The major taxa found included worms (Tubificidae) at greater than 85%, chironomids (7.4%), and mollusks (5.5%). The USEPA determined that taxa richness within Lake Erie was poor. Taxa numbers ranged only from seven to ten per lake and one to five taxa per site. The eutrophic chironomids and oligochaetes were the most abundant taxa found in Lake Erie and Lake Ontario (USEPA, 1997b; 1998a).

Tissue analyses of fish taken from Lake Erie at Lackawanna indicated the presence of chlorinated organics, mercury and arsenic in 1978; polychlorinated biphenyls (PCBs) and some pesticides in 1979 and 1980; and PCBs, mercury, and some pesticides in 1987. Concentrations of these substances in fish tissue from this area were not different from other relatively uncontaminated areas (USEPA, 1997b; 1998a).

Neither benthic invertebrates nor fish were surveyed or collected from Lake Erie as part of this RFI.

3.3.1.3 Surface Water

As part of the RFI, fifteen surface water samples were collected from Lake Erie in 1992 and 1994 (Figure 1-2) by Dames and Moore. Toluene and BEHP were detected in the duplicate sample, LE-5DUP, at concentrations of 0.44 μg/L and 37 μg/L, respectively; however, these compounds were not detected in sample LE-5. Calcium and sodium were detected in all 15 samples. Lead was detected in four samples ranging up to 5.7 μg/L. Total cyanides were detected in one sample at a concentration of 0.02 μg/L. A summary of compounds detected in Lake Erie surface water is provided in Table 3-5. The occurrence and distribution of COPECs is presented in Table 3-6. Complete analytical results are provided in Attachment E, Table E1.

3.3.1.4 Sediments

Fifteen sediment samples were collected from Lake Erie in 1992 and 1994 (Figure 1-2). Chloromethane, toluene, and 1,1,2,2-trichloroethane (TCA) were detected in one sample each at concentrations of 13 μg/kg, 4.1 μg/kg, and 5.3 μg/kg, respectively. Di-n-butylphthalate (DnBP)(100 μg/kg) and BEHP (five samples - 54 μg/kg to 630 μg/kg) were detected as well as 14 PAHs with total PAH concentrations ranging up to 9490 μg/kg (LE-5S DUP). Antimony, arsenic, barium, chromium, lead, mercury, nickel, selenium, and silver were also detected. A summary of detected compounds in Lake Erie sediments is provided in Table 3-7 and the occurrence and distribution of the COPECs is found in Table 3-8. The complete analytical results are provided in Attachment E, Table E2.

3.3.2 Blasdell Creek

STOP

The following sections describe the physical characteristics and habitat characterization of Blasdell Creek as well as a benthic invertebrate and fish survey, and analytical results of surface water and sediment sampling.

removal of a viable ecological habitat and the contaminated sediments, the Ship Canal will not be considered further in the ERA. Analytical data from historic sampling events is presented in Attachment J.

3.3.5 Smokes Creek

The following sections describe the physical and habitat characteristics and analytical results of surface water and sediment sampling conducted in Smokes Creek.

3.3.5.1 Physical Characterization

The SFA is roughly divided into north and south areas by Smokes Creek, which flows east to west and discharges into Lake Erie (Figure 1-2). Smokes Creek originates as two branches: the north branch, which drains areas in West Seneca, Lackawanna, and Orchard Park and the south branch, which drains areas in Lackawanna and Orchard Park. The two branches join in Lackawanna, approximately one-quarter mile east (upgradient) of the BSC property. The creek then flows under the Hamburg Turnpike and through the main part of the BSC site to Lake Erie. The Creek has a total drainage area of 329 square miles.

In the early 1960s, under a Riparian Rights Agreement between BSC and the ACOE, a flood control project was undertaken within Smokes Creek whereby BSC assumed responsibility for flood control actions within the portion of the creek from BSC Highway 9 to the mouth of the creek. The project was completed in the 1960s by BSC in cooperation with the ACOE and included channelization of the lowermost five miles of the stream and the renovation of some 30 bridges for the purpose of flood protection. The project improvements included widening and straightening the channel, regrading the side slopes, placement of rip-rap along the stream bottom and side slopes, installation of cellar jetties (sheet pile walls specially designed to control sediment build up) along the banks near the mouth of the creek, and placement of sheet piling and stone around the affected bridge abutments. The channelization resulted in an average bottom width of 32 feet for the portion of Smokes Creek from the Hamburg Turnpike to Lake Erie.

Currently, the average cross-sectional dimensions of Smokes Creek at BSC are 100 feet wide by 10 feet deep. The average width of the channel bottom between the Hamburg Turnpike and Lake Erie is approximately 32 feet. In the SFA and west of BSC Highway 9, the creek bottom is within the fill. East of BSC Highway 9, the fill is thinner and the creek penetrates it and the underlying sand unit to the top of the natural clay layer. Local topography is fairly flat, resulting in a low gradient. The slope of the Smokes Creek channel bottom within the site is on the order of 0.001 ft/ft.

The flow in Smokes Creek at the Hamburg Turnpike bridge is approximately 49.8 cfs (32.2 mgd) (Table 3-30). Flow increases below this point due to the contribution of three SPDES outfalls and the City of Lackawanna Sewage Treatment Plant (Figure 3-11). The combined flow rate is approximately 186 cfs (120 mgd). The capacity of the channel is between 3,600 cfs (approximately 2,400 mgd) where the two branches join and 3,900 cfs (approximately 2,500 mgd) at the mouth (ACOE, 1991). Based on the flood frequency curve for this area, this corresponds to a once in 10-year flood event, although such a volume was not reported in the period of record (October 1974 to August 1977), when maximum flows were on the order of 300 mgd. Flow in the creek is highly variable; there are periods of low flow where the Erie County sewage plant effluent and BSC discharges represent the bulk of the Creek's flow. Average background (upstream of BSC) flow rates of less than five mgd can occur in any month of the year and for up to six months at a time. Average background flow rates in Smokes Creek varied between 25.2 mgd (April through September) and 38.8 mgd (October through March) during the period of October 1974 to August 1977, with an overall average of 32.3 mgd.

The part of Smokes Creek that flows through the BSC site has been dredged periodically during the past 60 years to remove accumulated sediments caused by generally low-velocity flow through the SFA. In the fall of 1979, approximately 14,000 cubic yards were removed from the most downstream 2600 feet of the creek under an ACOE permit and placed in the on-site spoils impoundment, SWMU S-4. A hydrological study of Smokes Creek was performed in 1995, in response to a request from NYSDEC, to identify the potential for the creek to flood during a 100-year storm event whether dredging took place or not. The study indicated that, both with and without dredging, the creek was predicted to flood during a 100-year storm event. However, this was found to be inconsistent with actual conditions during previous 100-year (or near 100-year) storm events, during which the creek did not flood (BSC, 1995a). Discussions are ongoing with the ACOE regarding future relocation of the creek.

Smokes Creek received discharges from various plant operations, either directly or via the SRWT. Direct discharges containing spent pickle liquor, pickling rinse waters, oily and scale-laden waste waters, non-contact cooling water, and Galvanized Products Division process water were discontinued in 1970. In February 2002, the Gateway Environmental Wastewater Pre-Treatment Plant ceased discharges to Smokes Creek via Outfall 223. Subsequent discharges from Outfall 223 consisted of surface water pumped from the Gateway Metroport Ship Canal via BSC's Pump House No. 1 through December 2002, when pumpage from Pump House No. 1 will cease and only Pump House No. 5, which draws water from the Buffalo Outer Harbor, will be used to provide water to active BSC operations. Flow from Outfall 223 is estimated at 25 mgd. Outfall 223 is used for dilution to allow BSC to meet ammonia limits in Outfalls in 216 and 217. Smokes Creek also receives treated water from the City of Lackawanna sewage treatment plant (Figure 3-11), which has a rated discharge capacity of approximately 4.5 mgd and a discharge of 5.4 cfs (3.5 mgd).

3.3.5.2 Habitat Characterization

According to the NYSDEC Natural Heritage Program, the site is "adjacent to a Significant Coastal Fish and Wildlife Habitat, Smokes Creek Shoals" (Attachment B). According to Floyd Cornelius of the Bureau of Fisheries, Lake Erie Unit (Dunkirk, NY), the Smokes Creek Shoals habitat is mainly important as a walleye spawning area.

In 1991, New York State reclassified Smokes Creek from a Class D stream to a Class C[4] stream as a result of water quality improvements. Descriptions provided below are from the 1995 Dames & Moore field investigation unless otherwise noted.

Silt deposition and bank erosion in the creek are notable and bottom substrate is less than 30% gravel or rubble. Observation locations are listed in order from upstream to downstream (Figure 3-12), and the location numbering system is the same as used in previous Dames and Moore sampling events.

Observation Station SC-5 is just below and downstream of the Hamburg Turnpike bridge, and the creek there was very slow moving as well as at the other four locations on Smokes Creek. Although habitat conditions at SC-5 are less than optimal, and no aquatic animal life was seen, there are no obvious pollution sources nearby.

The SRWT enters Smokes Creek just above SC-4 (upstream), and at the time of the survey, it was carrying a brown oil-like substance that dispersed into "flecks" after mixing in Smokes Creek. The sediments examined immediately below the SRWT contained small quantities of oil, had an odor of petroleum, and no animal life was observed. Habitat conditions immediately upstream of the SWRT were improved, as indicated by the fact that mayfly (Order Ephemeroptera) larvae were found near the shore (mayflies are typically intolerant of pollution) despite the location of two effluents discharging Smokes Creek between SC-5 and SC-4, one from a BSC facility treating water from metal finishing operations, and the other from the City of Lackawanna Sewage Treatment Plant. Sheen was observed on the Creek's surface at SC-4, apparently from an unidentified source upstream of the confluence with the SRWT. Conditions appeared to improve downstream of SC-4, although sewage odors (presumably from the Lackawanna Sewage Treatment Plant) and the sheen persisted at each of the three downstream locations. Benthic invertebrates became more common near shore, although all the types observed are typically tolerant of organic pollution. A patch of sediment containing a petroleum-

[4] A Class C stream designation supports the propagation and survival of game fishes

like substance was observed at SC-1, which is near the confluence with Lake Erie. These observations suggested that past spills or other local influences may be factors in this part of Smokes Creek.

Wetlands

As requested by the USEPA, a survey of Smokes Creek was conducted to determine if jurisdictional wetlands were present along the banks of the creek during the June 2001 field activities. Identified wetlands, if present, were delineated as per the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (ACOE, 1987). This section outlines the methodologies used in that survey effort and the results of the survey activity.

Delineation Methodology

Wetlands are defined as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas" (40 CFR 230.3).

The survey consisted of a pedestrian reconnaissance of both banks of Smokes Creek, from its mouth at Lake Erie east to Hamburg Turnpike. To determine whether areas along the banks were wetlands, the three-parameter approach, as described in the ACOE delineation manual was used. Such an approach dictates that areas meeting the defined criteria of vegetation, soils, and hydrology will be designated as jurisdictional wetlands. The criterion for vegetation is defined as more than 50% of the composition of the dominant species from all strata must be categorized as hydrophytic or adapted to living in saturated areas. Plant species must be classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC) as defined in the United States Fish & Wildlife Service (USFWS) publication, *National List of Plant Species That Occur in Wetlands* (Reed, 1988). Soils are considered hydric if they meet the criteria defined by the National Technical Committee for Hydric Soils. Hydrology must be present to effect either permanent or periodic saturation of the soil.

Additionally, the requirements of the *Draft New York State Manual for Delineating Freshwater Wetlands Boundaries* (NYSDEC, 1996) were considered during the delineation process. The New York state manual is patterned after the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Interagency Manual, 1989) and tends to emphasize the vegetative parameter as the overriding factor in determining wetland boundaries.

To determine the presence of the first parameter, hydric soils, soil borings were placed below the "A" horizon (generally between 10 and 24 inches below grade) to study the nature of the soil. The hydric nature of soils can generally be determined by color changes that occur as a result of the chemical reduction of soil components due to extended periods of saturation or inundation. The Munsell Soil Color System has been developed in order to give values to these colors in an effort to make classification easier. The Munsell system utilizes three components in designating color to a soil (*i.e.*, hue, value, and chroma). The hue is related to one of the main spectral colors (red, yellow, green, blue, or purple) or various mixtures of these principle colors. The value refers to the degree of lightness, while the chroma notation indicates the color strength or purity. In mineral soils, there may be two or more colors within the same soil with the dominant color referred to as the matrix while the less dominant referred to as the mottle. Mottling tends to occur under fluctuating conditions of saturation, and mineral soils are considered hydric if the matrix chroma is two or less when mottling is present, or when the matrix chroma is one or less if no mottling is present.

Other soil characteristics such as high organic content, gleying, histic epipedons, sulfidic materials, aquic or peraquic moisture regime, and iron or manganese concretions are also indications of a hydric soil condition. The indicators described above cannot be applied to sandy soils due to their unique nature. Sandy soils are determined as hydric based upon the presence of high organic content in the surface horizon, vertical organic streaking in the lower horizons or the presence of wet spodosols (deep organic layers at the typical water table).

The second parameter, hydrology, is present when inundation or saturation of the soil, usually within 12 inches of the surface is present for more than five percent of the growing season.

Indicators of hydrology include observed inundation, observed soil saturation, watermarks, drift lines, sediment deposits, and drainage patterns in wetlands.

The last parameter, hydrophytic vegetation, is present when a predominance of the vegetation present is either obligate, facultative wet or facultative. The USFWS has compiled data on the habitat characteristics of plants of the United States, which categorizes plant species by their frequency of occurrence in a wetland habitat. These categories are as follows:

(1) Obligate Wetland Plants (OBL) are those species that occur almost exclusively in wetlands (>99% of the time),

(2) Facultative Wetland Plants (FACW) are those species that usually occur in wetlands (67 - 99%),

(3) Facultative Plants (FAC) are those species that are equally likely to occur in wetland or non-wetland (34 - 66%),

(4) Facultative Upland Plants (FACU) are those species that usually occur in no wetlands (67 - 99%); and

(5) Upland Plants (UPL) are those species that occur almost exclusively in uplands (>99%).

Wetlands delineation involves the determination of the boundary line between the areas in which the three hydric parameters are present and where they are not. Using perceived changes in elevation and vegetation as a guide, representative observation points were selected along the border of the wetland areas. At each of the observation points, soil borings were done to determine soil and hydrologic conditions and observations of floral species and surface hydrologic conditions were made on both the wetland and upland side. Based on professional judgment, the boundary was arbitrarily located between the two.

Delineation Results

As previously discussed, Smokes Creek is a broad, perennial stream that has been constructed and reconstructed into the landscape through the slag fill material that is the basic substrate throughout the SFA. As such, one of the major wetland indicators, hydric soils, was not present. The results of the wetlands survey indicated that, with one exception, all of the soil bordering Smokes Creek was slag material - rocks and cobbles, with very little fine particles. Indicators present suggest that the substrate is not a typical hydric soil, although the soil was saturated to within several inches of the ground surface adjacent to the creek. Therefore, the presence of wetlands was considered using the atypical situation criteria in the ACOE Delineation Manual.

The only wetland area along Smokes Creek, based on the atypical conditions criteria, was a narrow band of creek-influenced wetlands bordering Smokes Creek, present from the mouth of Smokes Creek running along both banks upstream to Hamburg Turnpike. This identification was based solely on the presence of hydrophytic vegetation and hydrology, as slag is not considered a hydric soil.

In general, the edge of Smokes Creek was defined by an exposed section of unvegetated slag covered by mud that usually extended one to two feet back from the water's edge of the water. In a few isolated areas, this unvegetated portion of the creek bank was as much as five to six feet in width and appeared as a mud flat. The exposed section of the bank is possibly tied to low water levels in the creek at the time of the survey, or the possible lowered water level of Lake Erie.

Bordering the edge of the exposed creek bank was a narrow ribbon of wetland herbaceous plants that was generally two to three feet in width. This ribbon of creek bank was dominated by the presence of spotted joe-pye-weed (*Eupatorium maculatum*, FACW), spotted touch-me-not (*Impatiens capensis*, FACW), common boneset (*Eupatorium perfoliatum*, FACW), lance-leaved goldenrod (*Solidago graminifolia*, FACW), giant goldenrod (*Solidago gigantea*, FACW), and purple loosestrife (*Lythrum salicaria*, FACW). Soft rush (*Juncus effusus*, FACW), blunt spikerush (*Eleocharis obtusa*, OBL), green bulrush (*Scirpus atrovirens*, OBL), broadleaf arrowhead (*Sagittaria latifolia*, OBL), and stalk-grain sedge (*Carex stipata*, OBL) were observed in the wetter areas and found uniformly the length of both banks of Smokes Creek. One large patch of Canada anemone (*Anemone canadensis*; FACW) was observed on the southern bank of the creek, approximately 300 yards upstream from the mouth.

Upland plants bordering this wetland community include white snakeroot (*Ageratina altissima*, FACU); Japanese knotweed (*Polygonum cuspidatum*, FACU): Canada goldenrod (*Solidago canadensis*; FACU); Dame's rocket (*Hesperis matronalis*, not indicated - NI); teasel (*Dipsacus sylvestris*, NI); ragweed (FACU); and field mustard (*Brassica rapa*, NI). A small number of wetland shrub and tree species were present, including red-osier dogwood (FACW) and black willow (*Salix nigra*, FACW).

At one location along the northern bank of Smokes Creek, just west of BSC Highway 5, a small bluff is present at the apex of a large bend in the creek that is characteristic of more typical wetland systems. The bluff is approximately one to two feet above the water surface and appears to be a point bar composed of silt that has been deposited there over time. The soil does demonstrate hydric characteristics, with a soil coloration of 10 YR 5/1 and saturation to within three inches of the soil surface. Broadleaf cattail (*Typha latifolia*, OBL), purple loosestrife, spotted touch-me-not, true forget-me-nots (*Myosotis scorpioides,* OBL), and rough goldenrod (*Solidago rugosa*, FACW) dominated the vegetative community in this area. Woody plants in this wetland included black willow, box elder (*Acer negundo*, FAC), and red-osier dogwood.

Smokes Creek Fisheries Characterization

The State University College at Buffalo conducted field studies at Smokes Creek in 1985 and 1986, investigating potential toxicity in the creek and occurrence of walleye spawning (Attachment K). The location of stations in these studies is shown on Figure 3-13. During the 1985 field study, the benthic fauna were characterized, sediment toxicity testing was conducted, and walleye spawning was assessed.

In 1994, the NYSDEC Division of Fish and Wildlife added PAHs[5] to the list of analytes. Concentrations of PAHs in young-of-the-year fish collected at Smokes Creek were below detection limits or quantitation limits (NYSDEC, 1994). This document is included as Attachment D.

More recent studies of the water quality in Smokes Creek (except as performed as part of this RFI) are not available. However, information from 1992 and 1993 toxicity testing (for SPDES permit purposes) of the BSC Galvanized Products Division discharges at outfalls 216 and 217, and a non-contact cooling and operating water discharge from the Coke Oven operations (outfall 223), concluded that there was no evidence of acute toxicity to test organisms from these discharges (Attachment K). The State University College at Buffalo conducted field studies at Smokes Creek in 1985 and 1986 (Spotila *et al.*, 1986, 1987) to investigate potential toxicity and occurrence of walleye spawning in the creek (Attachment K). The stations used in these studies are identified on Figure 3-13. Benthic community survey data indicated a dominance of oligochaete worms at all stations with the greatest numbers at Stations 3, 4, and 5 where sediments consisted predominantly (60-88%) of silts and clays. Sediments at Stations 1 and 2 consisted mostly of sand, gravel, and cobble, whereas Stations 6 and 7 consisted of a mixture of coarse and fine sediment particles. Sediment was collected during this study from Smokes Creek to determine its potential toxicity to waterfleas (*Daphnia magna*), walleye fry (*Stizostedion vitreum*), and a luminescent marine bacterium (Microtox test). Results from toxicity tests indicated acute (48 to 72 hour) sediment toxicity to walleye fry and *D. magna* at Stations 3 and 4, and for sediment from Station 2 for *D. magna*. Microtox tests indicated no acute toxicity.

The Smokes Creek fish community was surveyed by boat electrofishing on July 23 and August 27, 1996 (Table 3-14). Six segments of Smokes Creek were electrofished throughout approximately 3,300 yards (3,000 meters) of the creek from the creek mouth at Lake Erie to a point just upstream of the stream fork located above the Hamburg Turnpike bridge. Fifty-two

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[5]PAHs for this study included ACE, ACY, ANT, FLA, FLE, CHR, BaA, BaP, PYR, benzo(b)anthracene, benzo(k)anthracene, and PHE

fishes were tagged with vinyl anchor or streamer tags during the standardized survey on July 23. Largemouth bass, small mouth bass (*Micropterus dolomieui*), and catfish (*Ictalurus* sp.) were tagged in accordance with the NYSDEC scientific collecting permit that prohibited taking game species for this study. No tagged fish were recaptured during the August 27 survey.

The electrofishing effort yielded 517 individual fish representative of 22 species in 11 families (Tables 3-15 and 3-16). The catch consisted of:

- 51.3% sport/game fish species [sunfishes, pike (*Esox lucius*), trout (*Salmo* sp.), and perch (*Perca* sp.)]
- 33.6% forage species [minnows, shad, and silversides (*Labidesthes sicculus*)]
- 15.1% non-game species [bullhead catfish, suckers, and freshwater drum (*Aplodinotus grunniens*)].

The dominant fish families represented in the sample were:

- Centrarchidae (sunfishes): 50.5 percent
- Cyprinidae (minnows): 38.4 percent
- Ictaluridae (catfishes): 5 percent
- Catostomidae (suckers): 4.7 percent.

Relative abundance of fish was greater downstream of the Hamburg Turnpike than upstream of the Hamburg Turnpike (Table 3-17).

In the 1996 survey, external physical abnormalities in the form of parasites, lesions, infections, or eroded fins were detected in six of 113 fish (5.3%) upstream of the Hamburg Turnpike and in 11 of 404 fish (2.7%) downstream of the Hamburg Turnpike (Table 3-18). This is a relatively low incidence of external abnormalities, and is below that from the relatively unpolluted reference tributary (Smith *et al.*, 1994).

Data from the 1996 survey indicate that Smokes Creek fish community is dominated by non-migratory fish species of intermediate environmental tolerance (Tables 3-19). Sixteen of the 22 species found in Smokes Creek are classified as "intermediate tolerance" species, and the other six species observed are classified as "tolerant" species (USEPA, 1989c). The fish community represents five feeding guilds, which include nine insectivores, six piscivores, five omnivores, one generalist, and one invertebrate specialist.

A range of age classes of many of the fish species was observed in Smokes Creek (Table 3-20). Young-of-the-year fishes were observed in eight of 22 (36%) species, juveniles were observed in 14 of 22 (64%) species, and adults were observed in 18 of 22 (82%) species. A full spectrum of age classes was observed for seven species.

The fish community characterized by numerous resident, age-structured populations of intermediate tolerance fish species, appears to be consistent with the limitations of the low quality physical habitat of Smokes Creek.

Previous Fisheries Studies

A fisheries investigation that was performed in 1928 (NYS Conservation Department, 1928) is likely indicative of conditions in Smokes Creek as they existed during the early development of the Lackawanna Site. A total of eight species was collected from four different families. Four species were collected in 1928 that were not present in the 1985, 1986, and 1996 collections, including striped shiner (*Notropis chrysocephalus*), central stoneroller (*Campostoma anomalum*), johnny darter (*Etheostoma nigrum*), and northern hogsucker (*Hypentelium nigricans*). These four species typically inhabit moderately flowing water bodies with coarse bottom substrates (*e.g.*, gravel), and a change in these conditions, particularly at upstream stations, may be partially responsible for their absence in later studies.

A fisheries investigation was performed in Smokes Creek in 1985 and 1986 (Spotila *et al.*, 1986; 1987) (see Figure 3-14). Results of the 1985 survey indicated that species diversity was relatively low in Smokes Creek at the time. A total of 11 species from seven different families was collected (Attachment G). Fish sampling data obtained in 1986 suggested that the Smokes Creek fishery might have been adversely impacted by site-related stressors (Spotila *et al.*, 1987); however, this statement was not substantiated by confirming data. Of the 305 total fish collected in April/May 1986 at Station 3, 103 fish (34%) were found dead. At Station 5, 12 of 103 fishes (12%) were found dead. Dead fish found at both sites included white sucker (*Catostomus commersoni*), rainbow trout (*Salmo gairdneri*), northern pike, golden shiners (*Notemigonus crysoleucas*), and yellow perch (*Perca flavescens*). The cause of the fish mortality was not established. Observed fish species diversity in 1986 was similar to that reported in 1985, with a total of 10 live species from seven different families collected. However, 89% (270 of 305) of all fish collected were from one species (white sucker), indicating relatively low diversity in Smokes Creek in 1986.

A comparison of current data with historical (1928, 1985, 1986) fisheries data taken from Smokes Creek is provided in Table 3-31. The total number of observed live species was lowest in 1928 (8), intermediate in 1985 and 1986 (11 and 10, respectively), and highest in 1996 (22). A similar trend was observed for the total number of live fish families, with the lowest number occurring in 1928 (4), intermediate in 1985 and 1986 (7), and highest in 1996 (11). Four species were collected in 1928 that were not present in the 1985, 1986, and 1996 collections: striped shiner, central stoneroller, johnny darter, and northern hogsucker. However, caution should be used in comparing these data as the exact sampling locations, gear types and effort were not documented in the 1928 study.

The environmental tolerance of fish present in Smokes Creek appears to have shifted from tolerant toward intermediately tolerant over time. The fact that only one intolerant species (northern hogsucker) has ever been observed in Smokes Creek (1928) may reflect the industrialized nature of the area that has been in place for over a century. The presence of tolerant species in Smokes Creek was greatest in 1986 (50%), compared to the percentage of tolerant species observed in 1928 (38%), 1985 (36%), and 1996 (27%) (Figure 3-18). Intermediate tolerance species were most abundant in 1996 (73%), followed by 1985 (64%) and 1986 and 1928 (each with 50%), suggesting that there may have been improvement in conditions over time. The trophic makeup of the fish community in Smokes Creek has been relatively consistent among the sampling periods, with the greatest percentages of fish consisting of insectivores, omnivores, and piscivores (Table 3-31).

Based on the comparison of the Smokes Creek fisheries community described in previous studies with the results of the 1996 study, it appears that the diversity of the fish community in Smokes Creek has improved over the past 70+ years.

Physical habitat was also evaluated using the QHEI as provided in the USEPA's RBP (USEPA, 1989c). The QHEI ranks several physical and chemical parameters to emphasize biological relevant features such as substrate, instream cover, channel morphology, and riparian and bank structure. Higher index scores represent increasing habitat quality. The QHEI scores for the six selected stream segments ranged from 50 to 73 (Table 3-9), placing the majority of creek habitat generally in the "fair" category, although only the most upstream station (Station 6) can be considered a reference area. Habitat index scores tended to increase from upstream to downstream with the highest scores near the mouth and lower segment of Smokes Creek, due principally to improvement in substrate and cover. The lowest scores occurred for the two furthest upstream segments, principally due to poor substrate characteristics. Both Stations 5 and 6 are upstream of the majority of discharges from the site.

3.3.5.3 Surface Water

Basic water quality parameters were measured at six locations in Smokes Creek (Table 3-32). The following ranges in these parameters were recorded:

- Water temperature: 21.9 to 27.8°C
- Dissolved oxygen concentration: 5.1 to 8.4 milligrams per liter (mg/L)
- pH: 7.5 to 8.5
- Conductivity: 496 to 898 μmhos/cm
- Secchi depth: 0.8 to 2.0 m
- Turbidity: 19 to 43 nephlometric turbidity units (NTU).

These measurements indicate that, at the time of sampling, the creek had moderate dissolved and suspended solids concentrations, normal pH levels, acceptable dissolved oxygen levels, and slightly turbid waters.

VOCs

A total of 23 water samples were collected in 1991, 1994, and 1995 for analysis of VOCs (Figure 1-2; Attachment L, Table L1). Halogenated hydrocarbons [*i.e.*, bromodichloromethane, dibromochloromethane, bromoform, chloroform, methylene chloride, TCE, vinyl chloride, trans-1,2-dichloroethene (DCE), 1,2-dichloroethane (DCA)] were detected at concentrations between 0.41 μg/L and 14 μg/L. BTX compounds were detected up to 4 μg/L.

SVOCs

Eighteen samples were collected in 1991, 1994, and 1995 (Figure 1-2; Attachment L, Table L1) for analysis of SVOCs resulting in the detection of primarily phthalate compounds. Butylbenzylphthalate (BBP), di-n-octylphthalate (DnOP), diethyl phthalate (DEP), DnBP, and BEHP were detected at concentrations between 0.2 μg/L and 24 μg/L. Trace amounts of dichlorobenzenes (DCBs) (up to 0.1 μg/L), 2,6-dinitrotoluene (0.2 μg/L) and two PAHs (FLA – 0.1 μg/L, NAP – 1.3 μg/L) were also detected.

Inorganics

Arsenic, barium, cadmium, calcium, chromium, lead, nickel, selenium, and total cyanides were also detected.

Detected compounds are tabulated in Table 3-33; the occurrence and distribution of COPIs are presented in Table 3-34. Complete analytical results are provided in Attachment L, Table L1.

3.3.5.4 Sediment

Fifteen sediment samples were collected from Smokes Creek in 1994 and 1995 for analysis of VOCs, SVOCs, and metals with the following results.

VOCs

BTX compounds were detected in up to three samples at concentrations ranging from 7 µg/kg to 270 µg/kg. Halogenated compounds (*e.g.*, chlorobenzene, methylene chloride, and trichlorofluoromethane) were detected at concentrations between 2 µg/kg and 130 µg/kg, carbon disulfide was detected at concentrations between 4.6 µg/kg and 37 µg/kg, and MEK was detected at concentrations up to 100 µg/kg.

SVOCs

Sixteen PAHs were detected at concentrations between 72 µg/kg and 190,000 µg/kg and four phthalates were detected at concentrations between 70 µg/kg and 2400 µg/kg. Isophorone was detected at a concentration of 1100 µg/kg.

Inorganics

Antimony, arsenic, barium, cadmium, calcium, chromium, lead, mercury, nickel, potassium, selenium, silver, sodium, zinc, and total cyanides were detected in Smokes Creek sediments.

Detected compounds are tabulated in Table 3-35; the occurrence and distribution of COPECs are presented in Table 3-36. Complete analytical results are provided in Attachment L, Table L2.

3.3.6 South Return Water Trench

The following sections describe the physical characteristics, habitat characterization and analytical results of surface water and sediment sampling conducted in the SRWT.

antimony, arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and thallium.

Detected compounds are presented in Table 3-39; the occurrence and distribution are presented in Table 3-40. Complete analytical results are presented in Attachment N, Table N2.

3.4 WILDLIFE RECEPTORS OF INTEREST

As it is not feasible to evaluate the potential effects of COPECs for every wildlife species, ROIs have been selected to represent the organisms that might be present at the Site. Selection criteria for aquatic ROIs include the following factors specified in USEPA guidance (1989b, 1992, 1994, 1997a, 1998b):

1. the occurrence of potentially complete pathways for exposure of ecological resources to chemicals in environmental media;
2. resident communities or species exposed to the highest concentrations of chemicals in environmental media;
3. species or functional groups considered to be essential to, or indicative of, the normal functioning of the affected habitat; and
4. the feasibility of completing a quantitative assessment for the identified pathways and receptors.

3.4.1 Aquatic ROIs

Although benthic invertebrates and fish are not considered direct ROIs in this ERA, they are used in the food chain model to estimated ROI COPEC body burdens (Section 4). Benthic invertebrates (*e.g.*, amphipods, midge larvae, infaunal worms) live in sediment and feed on detritus or other organisms in the sediment. As such, they are directly exposed to the highest concentrations of chemicals in sediment. Benthic invertebrates are significant primary consumers in many freshwater systems and are prey species for some species of resident fish, amphibians, birds and mammals. Fish live in the water column and are directly exposed to chemicals in water. Fish serve as primary and secondary consumers and as prey species for higher trophic level organisms. The screening benchmarks identified for aquatic ROIs in this report are intended to be protective of aquatic biota community structure and function.

3.4.2 Terrestrial ROIs

3.4.2.1 Soil Flora and Fauna

Key organisms for which soil is the primary point of exposure to chemicals include plants, soil invertebrates, and soil microorganisms. Plants are exposed to chemicals in soil via direct contact between soil and roots. Plants provide food and shelter to other terrestrial organisms and are essential to normal ecological functioning. Soil invertebrates and microorganisms live in soil and are directly exposed to the highest concentrations of chemicals in this environmental medium. Soil invertebrates and microorganisms are important in the breakdown of plant litter and the development of soils as suitable substrates for plants. Soil invertebrates also are an important food resource for birds and mammals. The screening benchmarks identified for soil ROIs in this report are expressed as chemical concentrations in soil and are intended to be protective of plant and invertebrate community structure and function.

3.4.2.2 Wildlife ROIs

In contrast to soil ROIs, exposure assessment methods for wildlife require the selection of individual species to represent larger trophic groups. Selection of particular wildlife species as ROIs were based on expected presence in the Lackawanna area determined from range maps, representation of relevant trophic groups, and availability of exposure data. Bird and mammal ROIs are selected to represent maximally exposed or sensitive species.

Wildlife ROIs selected to characterize exposures received from the Site include the following species:

a. Omnivorous waterfowl - mallard duck (*Anas platyrhynchos*);

b. Piscivorous bird - great blue heron (*Ardea herodias*);

c. Carnivorous mammal – raccoon (*Procyon lotor*);

d. Carnivorous bird (macroinvertebrates) – spotted sandpiper (*Actitus macularia*);

e. Herbivorous mouse - deer mouse (*Peromyscus maniculatus*);

f. Insectivorous mammal - short-tailed shrew (*Blarina brevicauda*);

g. Insectivorous bird - American robin (*Turdus migratorius*); and

h. Raptor - Red-tailed hawk (*Buteo jamaicensis*).

3.5 EXPOSURE PATHWAYS

The exposure pathways to be examined through the evaluation of ROIs include:

1. Surface water

    a. Direct contact exposure to fish;

    b. Direct exposure to omnivorous waterfowl though the ingestion of surface water; and

    c. Indirect exposure to piscivorous bird through the ingestion of fish.

2. Sediments

    a. Direct exposure to macroinvertebrates;

    b. Indirect exposure to omnivorous waterfowl through the ingestion of macro-invertebrates;

c. Indirect exposure to carnivorous mammals through ingestion of macroinvertebrates; and

d. Indirect exposure to carnivorous birds through ingestion of macroinvertebrates; and

e. Indirect exposure to raptors through the ingestion of a carnivorous mammal.

3. Surface soil

a. Direct exposure to plants;

b. Indirect exposure to a herbivorous mouse though the ingestion of plants;

c. Indirect exposure to an insectivorous mammal through the ingestion of insects;

d. Indirect exposure to an insectivorous bird through the ingestion of insects;

e. Indirect exposure to a raptor through the ingestion of herbivorous mice.

3.6 CONCEPTUAL SITE MODEL

The CSM describes the predicted relationships between ecological entities and stressors to which they may be exposed. It also describes the primary, secondary, and tertiary exposure pathways or co-occurrences among exposure pathways, ecological effects, and ecological receptors (USEPA, 1998b). The CSM for ecological risk assessment is described below and depicted in Figure 3-15.

At the Site, the source of COPECs (*i.e.*, slag and waste chemicals) may enter the environmental media and receptors through the following potential transport pathways:

- Soil transport to surface water through runoff and through leaching to groundwater, followed by groundwater discharge to surface water;
- Sorption/desorption in soil and between sediments and water;
- Uptake of bioavailable COPECs by terrestrial/aquatic organisms; and/or

- Biotransfer of COPECs within the food chain *i.e.*, from lower trophic level organisms to upper trophic level consumers.

3.7 Tier 1 Discussion And Conclusions

Habitat characterization was completed for the upland (terrestrial) and aquatic ecosystems at BSC Lackawanna. The terrestrial habitat is still in the relatively early stages of primary succession with forbs and cottonwoods as the dominant vegetation. Increasing avian and mammalian diversity has been observed since the first ecological evaluation conducted in 1993. Sampling indicated the presence of VOCs, SVOCs, metals and total cyanides.

The aquatic habitats have been characterized:

- Blasdell Creek formerly received discharges from BSC and the Erie County potable water treatment facility.
  - The Creek was recently reengineered in 1998.
  - A qualitative benthic invertebrate and a quantitative fish community survey were completed prior to dredging. A quantitative benthic invertebrate survey was completed in 2001, after channelization; metrics are inconclusive as upstream and downstream are both impacted. A comparison of fish survey data from 1928, 1985, 1986, and 1996 indicate improving species numbers, structure, and the number of pollution intolerant species.
  - Sampling of surface water and sediment has shown that both upstream and downstream locations contain SVOCs and metals. This may be indicative an upstream source.
- The NRWT is not considered habitat as it is a concrete-lined, partially covered man-made structure throughout most of its course. Fish observed in the NRWT have been sucked in through the intakes; many dead fish were observed within the trench.

Surface water and sediment sampling indicate the presence of VOCs, SVOCs, and metals.

- Surficial sediments of the Gateway Metroport Ship Canal were dredged by the ACOE in 2000, effectively removing previously detected contaminants and the benthic invertebrate community from which fish or birds might feed. Therefore, the Ship Canal will not be considered further in this ERA.

- The SRWT is a man-made concrete or brick-lined trench with some covered portions. The section between the wastewater pre-treatment facility and Times Square is not considered habitat as it covered or goes under a building. Portions north of Times Square offer minimal habitat; fish and aquatic plants were observed. Portions south of the wastewater pre-treatment facility to Smokes Creek were observed as habitat for aquatic vegetation, fish, mammals, and avian species. Surface water and sediment sampling results indicate the presence of VOCs, SVOCs, and metals.

- Smokes Creek is a channelized waterway that has been dredged periodically since the 1960s. Additionally:

    - Historically received discharges from BSC and currently receives discharges from the City of Lackawanna STP.

    - A qualitative benthic survey indicated pollution tolerant species. A fish community survey indicated improving species numbers, structure, and numbers of pollution intolerant species, despite limited physical habitat.

    - Due to improving water quality, NYSDEC recently upgraded Smokes Creek from a Class D to a Class C stream.

    - A narrow band of wetlands were identified based on hydrophytic vegetation and hydrology as slag is not considered a hydric soil.

- Surface water and sediment sampling results indicated the presence of VOCs, SVOCs, and metals in both upstream and downstream locations.

- Lake Erie is the recipient of all discharges from BSC-related water bodies including Blasdell Creek, Smokes Creek and the water return trenches. The Gateway Metroport Ship Canal received water from Lake Erie. The BSC shoreline comprises 2.5 miles of a total of 851 miles of Lake Erie shoreline. Surface water and sediment samples indicate the present of VOCs, SVOCs, and metals.

A conceptual site model was completed, and is provided as Figure 3-15, that describes sources of COPECs and pathways to ROIs for the BSC Lackawanna facility.

ATTACHMENT B

(from "Revised Draft RCRA Facility Investigation Report, Part III: Ecological Risk Assessment" Former Bethlehem Steel Corporation, July 1998.)

New York State Department of Environmental Conservation
270 Michigan Avenue, Buffalo, New York 14203-2999
(716) 851-7010

Michael D. Zagata
Commissioner

July 18, 1995

Mr. Bill Starkel
Six Piedmont Center
Suite 500
3525 Piedmont Road
Atlanta, GA 30305

Natural Heritage Request
Bethlehem Steel RCRA Facility
City of Lackawanna, Erie County

Dear Mr. Starkel:

I have reviewed our Natural Heritage Data for Significant Habitats and threatened and endangered species at the above location.

The referenced project is adjacent to a Significant Coastal Fish and Wildlife Habitat; Smoke Creek Shoals.

For more information, contact Mr. Steve Mooradian, Regional Fisheries Manager, NYSDEC Region 9, 128 South Street, Olean, NY 14760; phone (716)372-0645.

There are no threatened or endangered species listed at the site. The Significant Habitat and Natural Heritage files are continually changing. The information in this letter should not be substituted for an on-site survey that may be required for environmental assessment.

Sincerely,

Mark Kandel
Sr. Wildlife Biologist

MK/dah

cc: Mr. Steve Mooradian, Regional Fisheries Manager

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, Albany, New York 12233-4757
Phone: (518) 402-8935 • **FAX:** (518) 402-8925
Website: www.dec.state.ny.us

Erin M. Crotty
Commissioner

August 31, 2004

Christy L. Calhoun
AMEC Earth & Environmental
285 Davidson Ave, Suite 100
Somerset, NJ 08873

Dear Ms. Calhoun:

In response to your recent request, we have reviewed the New York Natural Heritage Program databases with respect to an Environmental Assessment for the proposed Bethlehem Steel Facility, site as indicated on the map you provided, located in the City of Lackawanna; Town of Hamburg, and Village of Blasdell, and City of Buffalo, Erie County.

Enclosed is a report of rare or state-listed animals and plants, significant natural communities, and other significant habitats, which our databases indicate occur, or may occur, on your site or in the immediate vicinity of your site. The information contained in this report is considered sensitive and may not be released to the public without permission from the New York Natural Heritage Program.

This project location is adjacent to a designated Significant Coastal Fish and Wildlife Habitat. This habitat is part of New York State's Coastal Management Program (CMP), which is administered by the NYS Department of State (DOS). Projects which may impact the habitat are reviewed by DOS for consistency with the CMP. For more information regarding this designated habitat and applicable consistency review requirements, please contact:

Jeff Zappieri or Vance Barr - (518) 474-6000
NYS Department of State
Division of Coastal Resources and Waterfront Revitalization
41 State Street, Albany, NY 12231

The presence of rare species may result in your project requiring additional permits, permit conditions, or review. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, at the enclosed address.

For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement on the presence or absence of all rare or state-listed species or significant natural communities. This information should NOT be substituted for on-site surveys that may be required for environmental impact assessment.

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

Sincerely,

Betty Ketcham [signature]

Betty A. Ketcham
Information Services
NY Natural Heritage Program

Encs.

cc: Reg. 9, Wildlife Mgr.
Reg. 9, Fisheries Mgr.

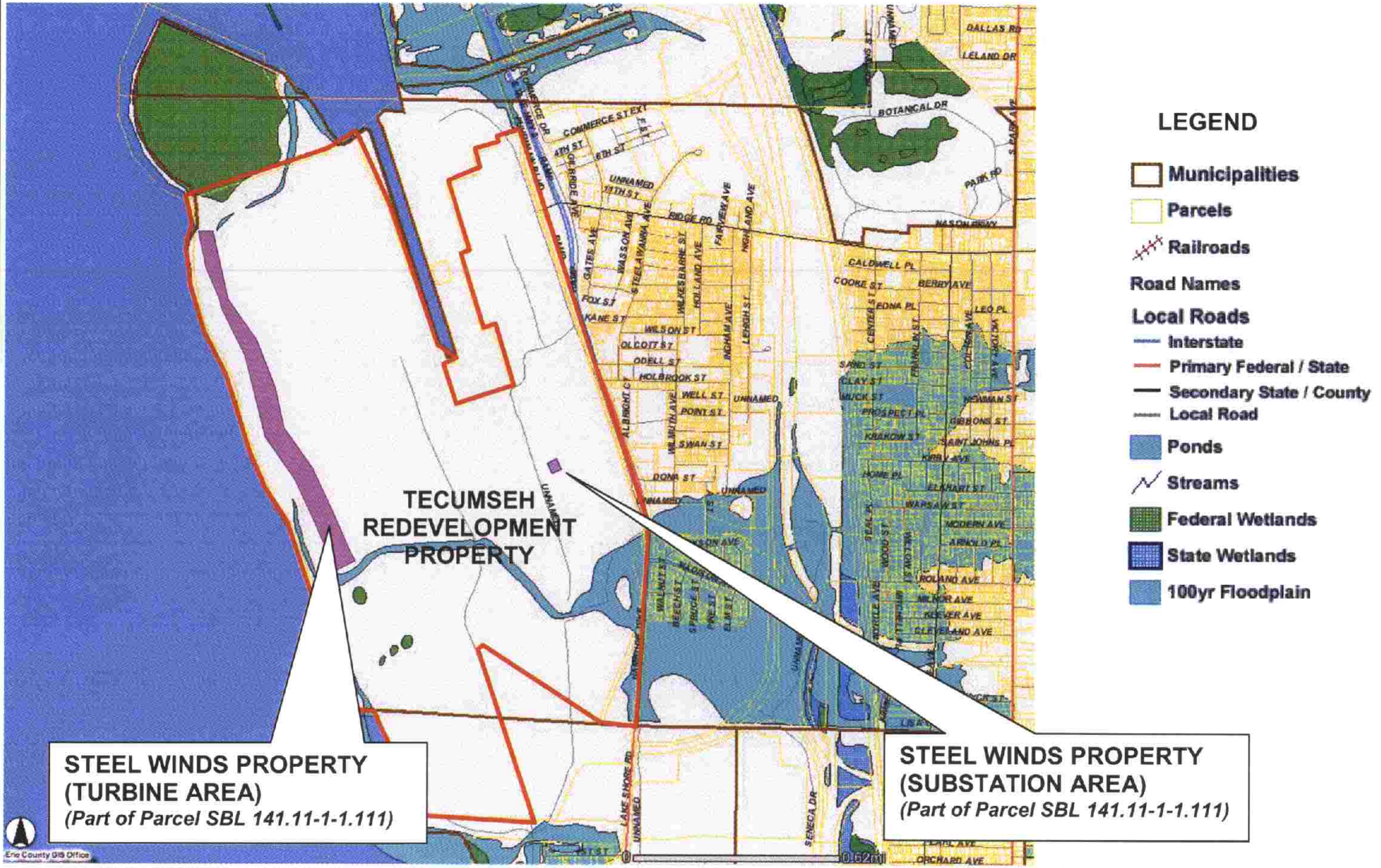
Natural Heritage Report on Rare Species and Ecological Communities

Prepared 25 August 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps of locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County ** Town Scientific Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Detailed Location	General Habitat and Quality	Office Use
* ERIE, NY STATE WATERS					
** CITY OF LACKAWANNA, CITY OF BUFFALO, NY STATE WATERS					
GULL NESTING COLONY Other	UNPROTECTED S?	A 1985-05-14	STONY POINT At south end of Buffalo Harbor, on lake (southwestern) side of breakwater which extends from Stony Point. Access is only by boat or through Bethlehem Steel.	Dredge spoil disposal site separated by dikes from Lake Erie. Low lying, gravelly, sparsely vegetated beach. Open water will eventually be eliminated as dredge spoils fill site. Huge slag pile at southern end, with steep banks down to beach. Surround More than 6000 nests, but colony is on diked dredge spoil disposal area.	4207877 S

1 Records Processed



TurnKey Environmental Restoration, LLC
726 EXCHANGE STREET
SUITE 624
BUFFALO, NEW YORK 14210
(716) 856-0635

PROJECT NO.: 0083-003-100

DATE: MARCH 2006

DRAFTED BY: BCH

STATE AND FEDERAL WETLAND/FLOODPLAIN MAP

BROWNFIELD CLEANUP PROGRAM APPLICATION

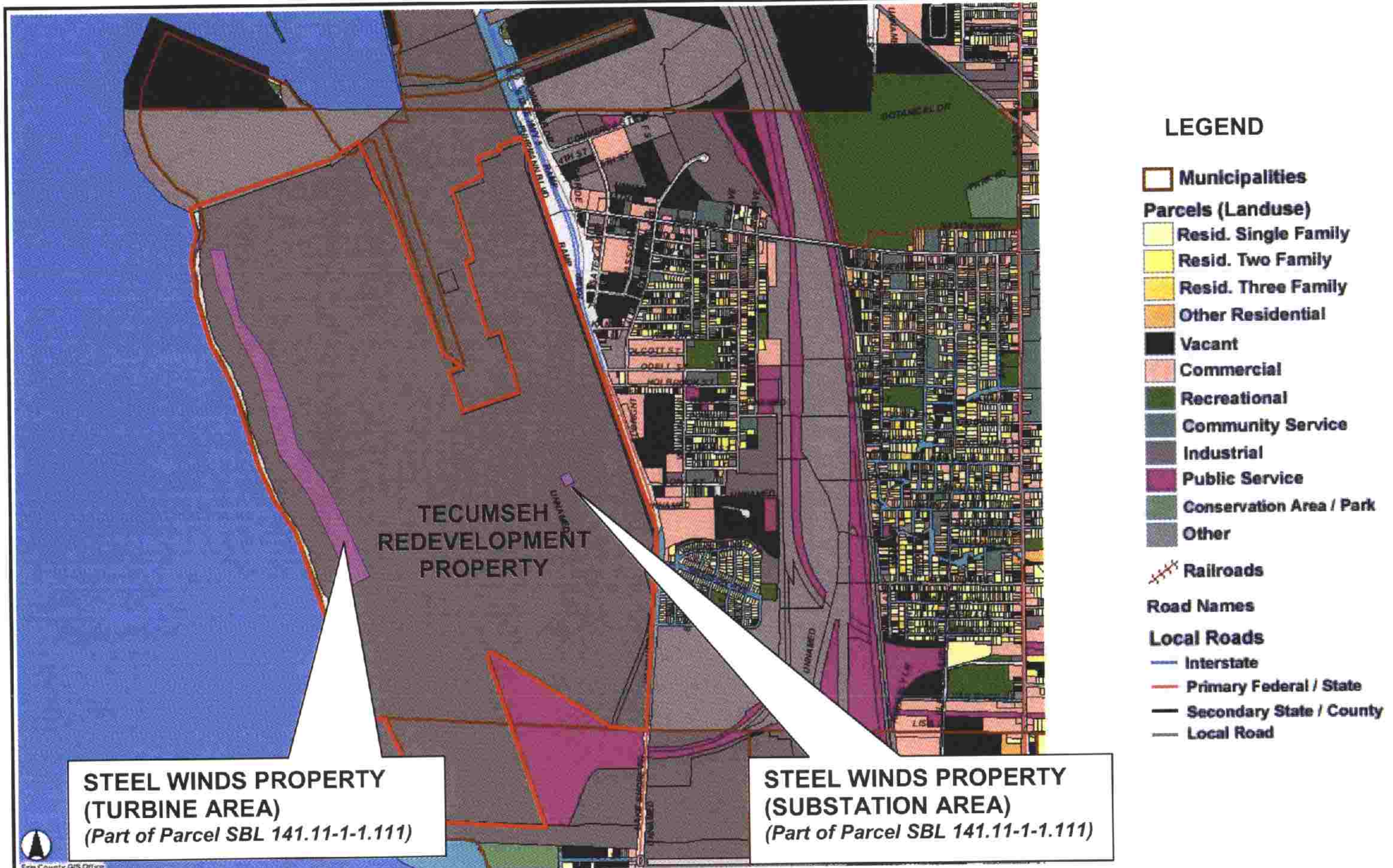
LACKAWANNA, NEW YORK
BQ ENERGY, LLC - STEEL WINDS SITE

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

FIGURE 11-1

ATTACHMENT 12

NEARBY LAND USE MAP



TURNKEY ENVIRONMENTAL RESTORATION, LLC

726 EXCHANGE STREET
SUITE 624
BUFFALO, NEW YORK 14210
(716) 856-0635

PROJECT NO.: 0083-003-100

DATE: MARCH 2006

DRAFTED BY: BCH

REGIONAL LAND USE MAP

BROWNFIELD CLEANUP PROGRAM APPLICATION

LACKAWANNA, NEW YORK
BQ ENERGY, LLC - STEEL WINDS SITE

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

FIGURE 12-1

ATTACHMENT 13

GROUNDWATER VULNERABILITY ASSESSMENT

Potential Vulnerability of Groundwater to Contamination

Groundwater at the Site maybe contaminated as a result of impacts from upgradient sources. There is a deed restriction (attached) on the use of groundwater from the entire approximately 1,100-acre BSC site and groundwater supply wells are not present on the site. Regionally, groundwater in the area has not been developed for industrial, agriculture, or public supply purposes. Municipal potable water service is provided offsite and onsite by the Erie County Water Authority. Groundwater vulnerability would potentially be related to potential environmental impacts on the offsite area to the east of the site, and related to the discharge of groundwater to Lake Erie.

Groundwater Flow/Recharge

Groundwater elevation maps completed during the RFI (Reference 1) indicate that groundwater flows west across the subject Site toward Lake Erie (Reference 2) with discharge into Lake Erie.

Recommendations

No recommendations at this time.

References:

1. United States Environmental Protection Agency (USEPA), National Enforcement Investigation Center (NEIC). 1988. RCRA Facility Assessment, Bethlehem Steel Corporation, Lackawanna, New York, September.
2. 'Phase I Environmental Site Assessment Report, Parcel B', Bethlehem Steel Corporation, March 2001.

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BETHLEHEM STEEL CORPORATION

OUNTY	$	56.00
	$	.00
	$	5.00
	$	.00
	$	.00
	$	.00
	$	.00
	$	.00
	$	.00
Total:	$	61.00

MORTGAGE TAX

Serial #

City/Town	$	.00
S.M.A.	$	.00
Trans. Auth.	$	.00
Total	$	.00

STATE OF NEW YORK
Erie County Clerk's Office

WARNING - THIS SHEET CONSTITUTES THE CLERKS ENDORSEMENT, REQUIRED BY SECTION 316-A(5) OF THE REAL PROPERTY LAW OF THE STATE OF NEW YORK DO NOT DETACH

DAVID J SWARTS
County Clerk

TRANSFER TAX

Transfer Tax	$	.00
Amount	$	.00

Transfer Tax #

D108976053

Box 374
JMP

DECLARATION
OF
CONDITIONS, COVENANTS AND RESTRICTIONS

Made By: Bethlehem Steel Corporation
1170 Eighth Avenue
Bethlehem, Pennsylvania 18016-7699

Dated: February 20, 1996

R 292929
779-16 RR 963

DECLARATION OF CONDITIONS, COVENANTS AND RESTRICTIONS

THIS DECLARATION OF CONDITIONS, COVENANTS AND RESTRICTIONS, made this 20th day of February, 1996, by Bethlehem Steel Corporation, a corporation duly formed and existing under the laws of the State of Delaware, authorized to do business in the State of New York, and having its principal place of business in the City of Bethlehem, Lehigh County, Pennsylvania, with a mailing address of 1170 Eighth Avenue, Bethlehem, Pennsylvania 18016-7699 (hereinafter "BSC"),

W I T N E S S E T H:

WHEREAS, BSC is the owner of certain noncontiguous lands adjacent to the eastern shore of Lake Erie situate partly in the City of Lackawanna, partly in the Town of Hamburg and partly in the Village of Blasdell, all in the County of Erie, State of New York, containing in the aggregate approximately 1,215 acres, and encompassing approximately 2.5 miles in an approximate north-south direction and approximately 1.4 miles in an approximate east-west direction, which were formerly part of the site of an integrated steel plant, and a portion of which lands is described and delineated more particularly in SCHEDULE B herein (said portion shall be hereinafter referred to as the "Premises"); and

WHEREAS, the history of the Premises is described more fully in SCHEDULE A herein; and

WHEREAS, certain governmental agencies and BSC have conducted environmental investigations at and near the Premises, the scope, result and impact of each of which are described more fully in SCHEDULE A herein; and

WHEREAS, BSC seeks to impose conditions, covenants and restrictions on the Premises for the purpose of promoting, benefitting, preserving and protecting the health and safety of the public and the environment all as related to the foregoing.

NOW, THEREFORE, (i) BSC, on behalf of itself, its successors and assigns, hereby declares and (ii) each and every person or entity who shall be an owner of the Premises or any part thereof, hereby covenants and agrees on behalf of itself, its successors and assigns, that the Premises or any part thereof shall be held, transferred, sold, conveyed, occupied and developed subject to the following conditions, covenants and restrictions:

1. The Premises or any part thereof shall be limited to industrial use only, which shall include manufacturing, assembling, warehousing, and related railroad, port and shipping activities, together with office space and other facilities including laboratories incidental to such uses, but incidental uses such as day care centers, nursery schools or other facilities that are designed or intended to be primarily for use or occupancy by multiple numbers of persons under the age of eighteen (18) years shall not be permitted.

2. No wells for the extraction or use of water from beneath the surface of the Premises or any part thereof shall be installed, built, permitted or utilized on the Premises or any part thereof for any purpose whatsoever; provided, however, that BSC may install, use, operate and maintain monitoring wells and treatment wells, including the extraction and treatment of water therefrom, solely for the purpose of monitoring, treating or remediating such water; and provided, further, that any other owner of the Premises or any

part thereof may install, use, operate and maintain monitoring wells and treatment wells, including the extraction and treatment of water therefrom, on the part of the Premises so owned by such owner, solely for the purpose of monitoring, treating or remediating such water.

3. Any activity or use not specifically permitted hereby or any activity prohibited pursuant hereto shall be forbidden.

A. <u>Purpose</u>.

It is the intent of BSC by means of said conditions, covenants and restrictions to promote, benefit, preserve and protect the health and safety of the public and the environment by preventing any activity or use not specifically permitted above or any activity prohibited pursuant to paragraphs 1 and 2 above.

B. <u>Conditions, Covenants and Restrictions to Run with the Premises</u>.

Said conditions, covenants and restrictions shall run with the Premises and every part thereof and shall bind all owners and occupiers of the Premises or any part thereof, and their respective successors and assigns; all parties claiming by, through, or under them or any of them shall be taken to hold, agree and covenant with all owners of the Premises or any part thereof, and their respective successors and assigns and each of them, to conform to and observe said conditions, covenants and restrictions.

C. <u>Enforceability</u>.

Said conditions, covenants and restrictions shall inure to the benefit of and be enforceable by BSC and by each and every person or entity, including BSC, who shall be an owner of the Premises or any part thereof, and their respective successors and assigns, and shall also benefit BSC, its successors and assigns, for so long as BSC shall (i) own any property either adjacent or proximal to the Premises or any part thereof or (ii) be responsible under any law, ordinance, rule or regulation for the presence of hazardous wastes or hazardous constituents or both upon or within the Premises or any part thereof or in said property adjacent or proximal to the Premises or any part thereof but said conditions, covenants and restrictions shall not give rise, by implication or otherwise, to a reciprocal condition, covenant or restriction burdening or binding upon the other lands or any part thereof of BSC benefitted hereby, by actions at law or by suits in equity. As it may be impossible to measure monetarily the damages which may accrue to the beneficiaries hereunder by reason of a violation of this Declaration, any beneficiary hereunder shall be entitled to relief by way of injunction or specific performance, as well as any other relief available at law or in equity, to enforce the provisions hereof.

The failure of any beneficiary hereunder to enforce any provision of this Declaration shall in no event be construed as a waiver of the right of that beneficiary or any other beneficiary hereunder to do so thereafter, as to the same or a similar violation occurring prior or subsequent thereto. No liability shall attach to BSC or any subsidiary or other affiliate of BSC (or any officer, director, employee, member, agent, committee or committee member of any of them) or to any other beneficiary hereunder (excepting, however, the subject owner in breach) for failure to enforce the provisions of this Declaration.

If BSC or any other beneficiary hereunder successfully brings an action to extinguish a breach or otherwise enforce the provisions of this Declaration, the costs of such action, including legal fees, shall become a binding, personal obligation of the owner in breach.

D. Amendments and Termination.

Any amendment or termination of this Declaration affecting any part of the Premises shall require the written consent of all owners of the Premises or any part thereof, which consent shall not be unreasonably withheld, and of BSC, or its successors or assigns, whose consent may be withheld in its sole discretion.

Any amendment or termination of this Declaration shall not become effective until the instrument evidencing such change has been duly recorded in the Erie County Clerk's Office.

Neither this Declaration nor any amendment to this Declaration shall be interpreted as permitting any action or thing prohibited by the applicable laws, ordinances, rules or regulations of any governmental authority having jurisdiction over the part of the Premises affected or by specific restrictions imposed by any other instrument relating to the Premises or to such part of the Premises.

No change of conditions or circumstances shall operate to amend this Declaration, and this Declaration may be amended only in the manner provided herein.

The determination by any court of competent jurisdiction that any provision of this Declaration is unenforceable invalid or void shall not affect the enforceability or validity of any other provision hereof.

IN WITNESS WHEREOF, BSC has executed this Declaration as of the day and year first above written.

BETHLEHEM STEEL CORPORATION,
by

ATTEST:

Assistant Secretary

A. E. Moffitt, Jr.
Vice President

ATTACHMENT 14

DESCRIPTION OF SITE GEOGRAPHY/GEOLOGY

Information related to the geography/geology/hydrogeology of the site was reported in the "Parcel B, Phase II Sampling Investigation Work Plan, Bethlehem Steel Corporation, Lackawanna, New York" August, 2001. Excerpts from this reference are included in this attachment to inclusion into the BCP Application.

ES2.2 Ecological Setting

Including the SFA, approximately one-half of the Site is not vegetated due to the presence of buildings, foundations, concrete pads, coal piles, roads, railroad tracks and slag fill. The remainder of the Site is vegetated primarily by grasses, shrubs and small trees. Almost all of the vegetated areas are in a very early stage of succession, lack substantive diversity and are low quality habitats.

The Site is located within the Erie-Niagara River basin. Viable aquatic habitats in the vicinity of the Site include Smokes Creek, Blasdell Creek, and Lake Erie. Several State wetlands are located within 2 miles of the Site.

ES2.3 Demography and Land Use

Current ownership of the Site is identified on Figure ES-6. Land use surrounding the Site includes residential, light and heavy industrial-commercial properties, and several public use areas.

Nearby residential areas include the community of Woodlawn located south of the Site and adjacent to Blasdell Creek, and several areas east of Route 5 and north of the ISG Lackawanna operations (the "Galvanized Products Division"). Numerous small commercial businesses are located offsite along Route 5 east and south of the Site.

Public recreational areas include two beaches within 2 miles of the Site, and two marinas north and within 1 mile of the Site. Fishing and boating activities are also common offshore of the Site in Lake Erie.

ES2.4 Regional Geology and Hydrogeology

The Site is located in the Erie-Ontario Lake Plain Physiographic Province of Western New York. The geology of the Erie-Niagara basin is described as consisting of unconsolidated deposits (predominantly of glacial origin) overlying Silurian- and Devonian-age sedimentary bedded or layered bedrock. The naturally occurring unconsolidated deposits in the area consist of the following three general types: (1) alluvial silt, sand, and gravel deposited during comparatively recent geologic time; (2) lacustrine sediments composed primarily of silt, sand, and clay deposited during the late Pleistocene Epoch; and (3) glacial till, a heterogeneous mixture of particles (i.e., clay, silt, sand, gravel, and cobbles) deposited directly from glacial ice during the Pleistocene Epoch. Relief in the area is generally flat and the result of pre-glacial erosion of bedrock and subsequent topographic modification by glaciation.

The bedrock formations in the region dip to the south at about 30 to 40 feet per mile and exhibit only very gentle folding. In the Erie-Niagara Basin, the major areas of groundwater are in glacial sand and gravel deposits and limestone and shale bedrock. The main sources of groundwater within the bedrock are fractures and solution cavities.

The quality of groundwater in the vicinity of the Site is generally fair with moderate levels of hardness (250-500 parts per million [ppm]), sulfate (100-500 ppm) and chloride (100-500 ppm). The entire area within 3 miles of the Site is served by municipal water companies that acquire their drinking water from Lake Erie.

ES2.5 Site Geology

As noted previously, slag fill deposits cover much of the Site, particularly near the lake. Below the fill, the natural surficial geology of the Site is composed principally of lake sediments consisting of silty sands that are underlain by lacustrine silts and clays and glacial till. Peat is also occasionally found between the sand and fill. Lying below the till is bedrock, which is composed mostly of dark gray and black fissile shale. A gray limestone has also been encountered in several of the borings drilled to bedrock.

The fill unit, which contains the SFA, covers the entire Site west of Route 5 and consists of iron-making and steel-making slag, dredge spoils, cinders, coke, ashes, and brick and steel construction debris generated from historic BSC activities combined with granular fill soils. The thickness of the fill is extremely variable; high ridges of fill more than 100 feet thick are present along the Lake Erie shoreline at the northwest corner of the Site, thinning to a few feet near Route 5.

ES2.6 Site Groundwater Regime

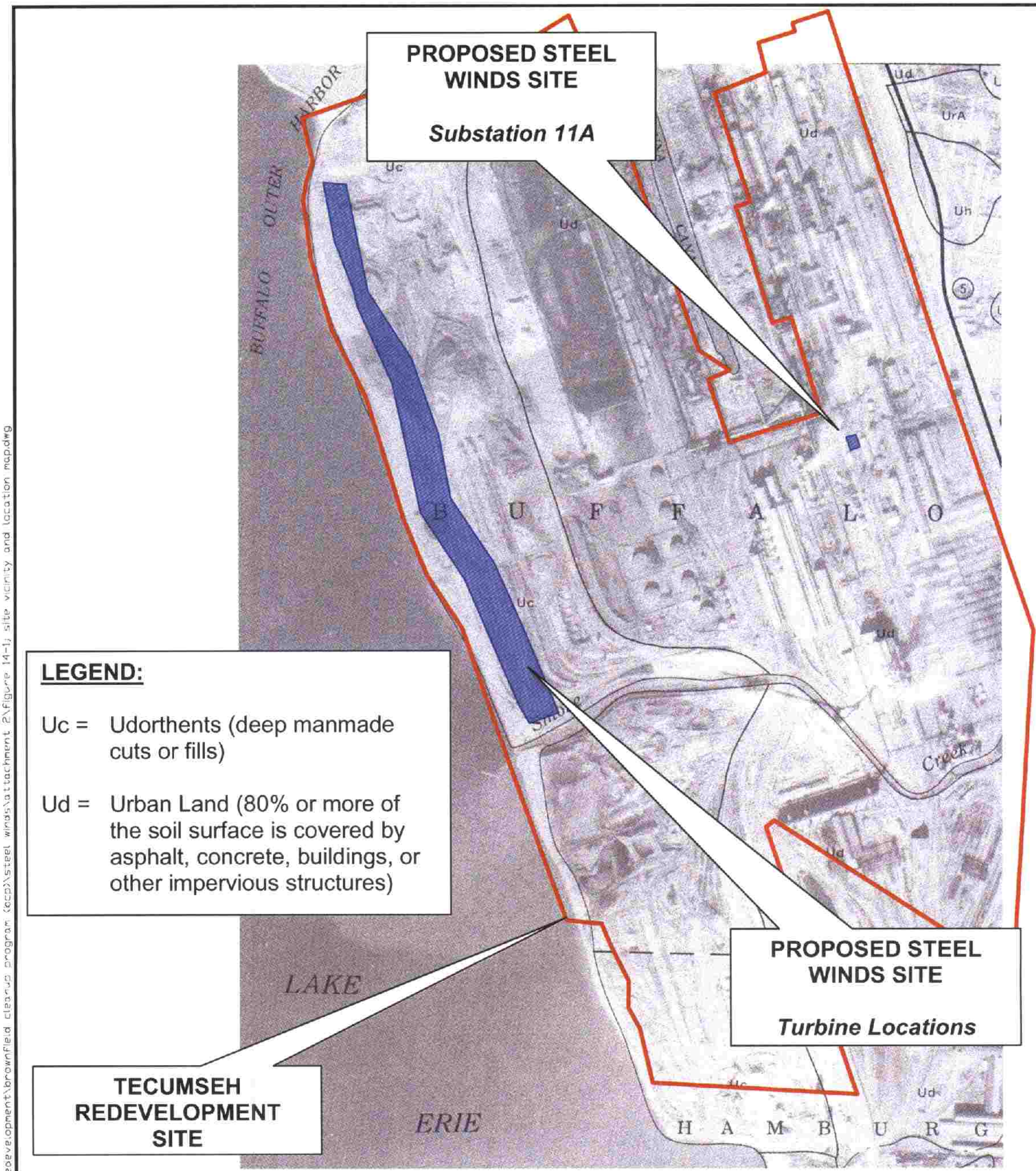
The Site's hydrogeology is dominated by its lakeshore setting and the characteristics of the Site's subsurface materials. Slag and other fill placement on the Site has created an extensive man-made surficial fill unit. The fill is underlain by a natural sand unit ranging in thickness from approximately 0 to 20 feet. The lower, saturated part of the fill, along with the entire natural sand unit, comprises a low-yield, shallow, unconfined water table groundwater unit. Its saturated thickness ranges from 10 to 30 feet. The water table unit is underlain by an aquitard consisting of silt, clay and till units that together range in thickness from 2 feet to more than 50 feet. Below this aquitard is a confined and saturated groundwater unit within the uppermost part of the bedrock. This unit is assumed to discharge into Lake Erie.

In general, groundwater flow in the water table aquifer (fill and sand units) is generally east to west across the Site toward Lake Erie and also locally toward Smokes Creek, Blasdell Creek, the Gateway Metroport Ship Canal and the Union Ship Canal. Groundwater elevations, contour lines and flow paths as determined by the most recent round of Site-wide groundwater monitoring (November 20, 2001) are presented on Figure ES-7 and ES-8 for the fill and sand units, respectively.

ES2.7 Groundwater Recharge and Discharge

Recharge to the Site water table is from rainfall and snowmelt. Most of the Site precipitation evaporates or infiltrates to the subsurface. Site runoff is minimal and, if present, is eventually intercepted by one of the surrounding water bodies (Blasdell Creek, Smokes Creek, the Gateway Metroport Ship Canal, the Union Ship Canal, Lake Erie or the Buffalo Outer Harbor. Recharge for the Site is estimated at 1.25 feet/year. This value has been used for calculations of groundwater discharge and chemical loading to the surface water bodies.

FIGURE 14-1



TURNKEY ENVIRONMENTAL RESTORATION, LLC
726 EXCHANGE STREET
SUITE 624
BUFFALO, NEW YORK 14210
(716) 856-635

PROJECT NO.: 0083-003-100

DATE: MARCH 2006

DRAFTED BY: BCH

SOIL TYPE MAP

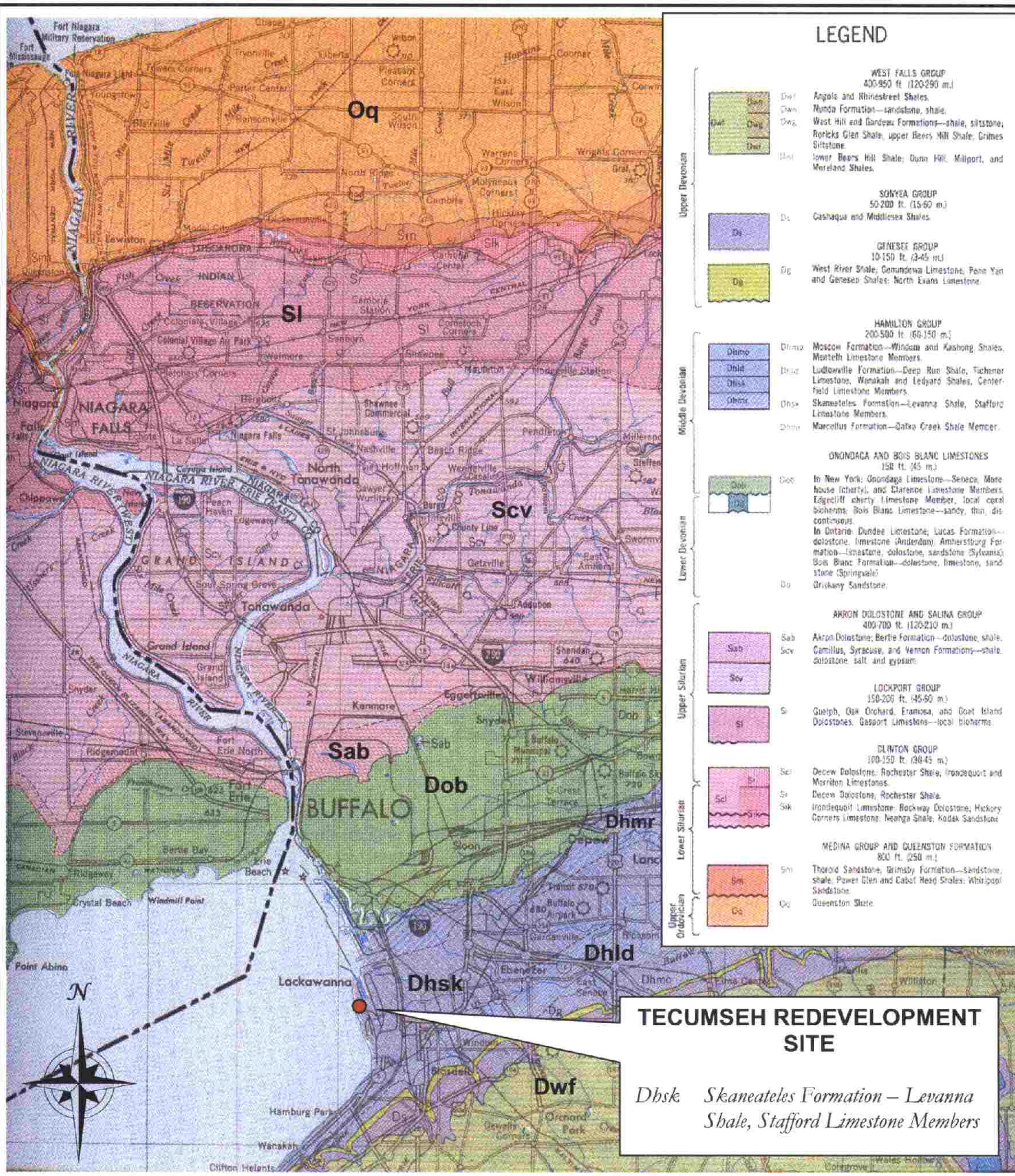
BROWNFIELD CLEANUP PROGRAM APPLICATION

BQ ENERGY, LLC - STEEL WINDS SITE
LACKAWANNA, NEW YORK

PREPARED FOR
TECUMSEH REDEVELOPMENT, INC.

FILEPATH:g:\cad\turnkey\tecumseh redevelopment\brownfield cleanup program (bcp)\steel winds\attachment 2\figure 14-1; site vicinity and location map.dwg

FIGURE 14-2



![TurnKey Environmental Restoration, LLC]

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REGIONAL BEDROCK MAP

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FILEPATH\g\cad\turnkey\tecumseh redevelopment\brownfield cleanup program (bcp)\steel winds\attachment 2\figure 14-2) regional bedrock map.dwg