Attachment 6c

Report of Findings Sampling Visit Work Plan Implementation for former Atlantic Wood Industries, Inc. Facility, April 1999

REPORT OF FINDINGS SAMPLING VISIT WORK PLAN IMPLEMENTATION FORMER ATLANTIC WOOD INDUSTRIES, INC. FACILITY ATHENS, NEW YORK EPA I.D. NO. NYD095240610

Prepared for:

Atlantic Wood Industries
P. O. Box 1608
Savannah, GA 31402

Prepared by:

KU Resources, Inc.

April 1999

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REPORT OF FINDINGS
SAMPLING VISIT WORK PLAN IMPLEMENTATION
FORMER ATLANTIC WOOD INDUSTRIES, INC. FACILITY
ATHENS, NEW YORK
EPA I.D. NO. NYD095240610

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1.0 INTRODUCTION

Atlantic Wood Industries, Inc. (AWI) is the former owner of a wood preserving facility located in Athens, New York. In 1980, AWI protectively filed for Interim Status under the Resource Conservation and Recovery Act (RCRA). AWI subsequently determined that it was a small quantity generator of hazardous waste materials, and beginning in 1983, attempted to extricate itself from Interim Status. In early 1996, AWI sold the facility to Northeast Treaters, Inc., which currently operates the wood preserving facility. As part of the sales agreement, AWI agreed to resolve any issues related to the *"Final Report for the Corrective Action Prior to Loss of Interim Status"* (CAPTLOIS) that was prepared prior to the sale of the facility in 1996

The facility was built in 1977, and has undergone a number of upgrades since that time. Most notably, the area around the original drip track was paved with concrete to form a large drip pad, and the entire process area and drip pad was placed inside a building. This drip pad is currently in compliance with RCRA Subpart W requirements, which include: sealing/coating the concrete surface with a chemical resistant material, and maintaining that chemical-resistant surface; removing chemical build-up and cleaning the drip pad on a routine basis to allow for weekly inspections; and having a Professional Engineer inspect the drip pad on a yearly basis and certify its compliance with the applicable Subpart W requirements.

In March 1989, the *"Final Report for the Corrective Action Prior to Loss of Interim Status"* (CAPTLOIS) for the facility was prepared by A.T. Kearney (a contractor to U.S. EPA). This Report noted that "the bottom of the CCA Solution Recycle Sump could not be inspected during the site visit since it contained CCA solution." The Report went on to recommend that the sump be inspected for integrity, and "should the inspection reveals (sic) cracks or other deterioration, soil sampling is recommended. The soil sampling should include arsenic and chromium."

This sump remains in use at the facility, resulting in the continued inability to thoroughly inspect the bottom and interior surfaces to evaluate the integrity of the unit. As a result, sampling was performed immediately around the sump in June 1997 to respond to the sampling recommendations in the CAPTLOIS Final Report. A sample was also collected from an area presumed to be representative of background conditions.

The results of this investigation were presented in the *"Report of Findings, CCA Solution Recycle Sump (SWMU 3) Integrity Evaluation"* prepared by KU Resources, Inc. in August 1997 (Attachment A). This investigation indicated that, in the vicinity of the CCA Solution Recycle Sump, approximately five feet of granular fill material overlie native clay. This suggests that the area was excavated for the purpose of constructing the sump, and subsequently backfilled with materials from an off-site source. Samples collected from the clay unit at depth intervals located beneath the base of the sump were submitted for laboratory analysis. Arsenic and hexavalent chromium concentrations in the native clay were below detection limits for all samples, while chromium concentrations in the native clay were similar to the concentration detected in the background sample.

The August 1997 Report of Findings concluded that "CCA wood preservatives have not been released into the native clay soils immediately underlying the Sump. Given the physical setting of the Sump, it can therefore be further concluded that the integrity of the Sump structure is sufficient to prevent releases of wood preservative solution in the Sump."

Concurrent with the 1997 investigation of the CCA Solution Recycle Sump, AWI was notified that the New York State Department of Environmental Conservation (NYSDEC) would be assuming the lead role from U.S. EPA. NYSDEC conducted a Visual Site Investigation on September 12, 1997 and reviewed the information acquired during AWI's June 1997 investigation activities. In a letter dated December 28, 1997, NYSDEC requested that a Sampling Visit (SV) Work Plan be submitted to address six specific points in their SV Outline. This SV Outline included sampling requirements for the following three additional areas:

- North Sump (treating cylinder door pit)
- Drip Pad; and
- Former Underground Effluent Tank/Piping.

The SV Work Plan was submitted to NYSDEC on September 10, 1998, and was revised in implementation in response to NYSDEC comments dated September 22, 1998. A Health and Safety Plan was also submitted on September 29, 1998 in response to a NYSDEC request, and revised on October 8, 1998 in response to NYSDEC comments.

2.0 SAMPLING RATIONALE

The collection of samples from directly beneath the bottom of the sumps, tank or piping was not attempted, due to access difficulties and the possibility of destroying the long-term integrity of these structures. Rather, it was felt that the collection of samples of backfill and natural soils from immediately adjacent to and below the base of the sumps, tank, and piping would provide representative data to evaluate the potential for releases from these units. Based on facility construction drawings and information collected for the August 1997 Report of Findings, the sumps were constructed by excavating a pit into natural cohesive (clay) soils, placing granular backfill as a base of the concrete sump floor, and pouring the sump floor/wall structures. The tank cavity and pipe trenches were also reportedly excavated in the natural clay, and the area surrounding them backfilled with granular backfill. This natural clay unit is of low permeability, and is laterally and vertically extensive. As a result, any releases would be restricted to the granular backfill materials in the immediate vicinity of the units, rather than migrate downward or laterally through the low-permeability clay unit. The August 1997 sampling results confirm this conceptual migration model. In that investigation, it was determined that the quality of the uppermost portion of the clay unit (immediately beneath the granular backfill) adjacent to the South Sump was not affected by constituents of interest.

Given the specific type of wood preservative used at this facility (CCA), samples were analyzed for arsenic, total chromium, and hexavalent chromium.

3.0 INVESTIGATIVE METHODOLOGY

Soil sampling was performed on November 12 and 13, 1998. Samples were collected using direct-push sampling equipment, driven by a Geoprobe® sampling unit. Soil samples were collected in either two- or four-foot disposable acetate liners placed inside of the direct-push sampling tubes. All down-hole equipment was decontaminated between samples.

Soil samples were collected from a total of sixteen borings (C-1 through C-15, and C-B) at the locations described below. Boring locations are presented on Figure 1. The borings were placed as close to each process unit as practicable, given physical constraints presented by overhead structures, at-grade structures and equipment, and subsurface utilities and foundations. For the locations inside the building, the building's concrete floor slab was cored to provide access to the underlying soil.

Following completion of sampling, boreholes were backfilled with bentonite hole-plug. For the boring locations inside the building, the concrete slab was patched with concrete and a bentonite gasket subsequent to borehole backfilling.

Soil samples were submitted under chain-of-custody protocols via overnight express for analysis. Analyses were performed by Accutest Laboratories of Dayton, NJ for total chromium, hexavalent chromium, and arsenic. The samples collected from the granular fill materials were identified for initial analysis, with the remaining samples being held by the laboratory. These held samples were also analyzed following receipt of the fill material analyses.

The sampling performed in association with the individual investigation areas is described below.

3.1 CCA Solution Recycle Sump ("South Sump")

As with the previous investigation, the collection of samples through the bottom of the Sump was not attempted, due to access difficulties and the possibility of destroying the long-term integrity of the Sump bottom. Three borings (C-5, C-7, and C-9) were advanced immediately adjacent to the Sump. Refusal was encountered in Borings C-5 and C-9 at depths of 5.5 and 7.5 feet, respectively. Samples of the backfill materials immediately above the depth of refusal were collected for analysis. In Boring C-9, where concrete was apparently encountered at a depth of 7.5 feet, an additional sample was able to be collected from the 7.5- to 8.0-foot interval. Boring C-7 did not encounter refusal and was advanced to just below the backfill/natural soil interface of 7.0 feet. Soil samples were collected in Boring C-7 from the base of the backfill material and from the natural soils immediately underlying this backfill. It should be noted that Boring C-7, in addition to being located adjacent to the South Sump, is located immediately adjacent to the southern section of piping associated with the former underground effluent tank and was also used to assess the soils that underlie the piping.

3.2 Treating Cylinder Door Pit ("North Sump")

Three soil borings (C-4, C-10, and C-14) were advanced immediately adjacent to North Sump. As with the South Sump, these borings were located adjacent to the door pit rather than in the pit itself, in order to avoid compromising the long-term integrity of this pit structure. All of these borings were advanced to just below the backfill/natural soil interfaces of 6.5, 7.5, and 2.0 feet, respectively. Soil samples were collected in each boring from the base of the backfill material and from the natural soils immediately underlying this backfill. It should be noted that Boring C-14, in addition to being located adjacent to the North Sump, is located immediately adjacent to the Drip Pad and was also used to assess the soils that underlie the Drip Pad.

3.3 Drip Pad

Five borings (C-11, C-12, C-13, C-14, and C-15) were advanced at 25-foot intervals along the drip track, in the area outside of the rails in order to maintain the long-term integrity of the concrete between the rails. . All of these borings were advanced to just below the backfill/natural soil interfaces of 3.0, 2.5, 2.0, 2.0, and 3.0 feet, respectively. Soil samples were collected in each boring from the base of the backfill material and from the natural soils immediately underlying this backfill. It should be noted that Boring C-14, as discussed previously, was located such that it could also be used to assess the soils that underlie the North Sump.

3.4 Former Underground Effluent Tank/Piping

Two soil borings (C-3 and C-6) were advanced in the approximate area of the northern section of piping (from the Door Pit to the tank). Both of these borings were advanced to just below the backfill/natural soil interfaces of 4.5 and 14.0 feet, respectively. Two additional soil borings (C-7 and C-8) were advanced in the approximate area of the southern section of piping (from the South Sump to the tank). These borings were also advanced to just below the backfill/natural soil interfaces of 7.0 and 6.5 feet, respectively. Samples were collected at each location from the base of the backfill material and from the natural soils immediately underlying this backfill.

In order to evaluate soil quality beneath the remainder of the tank area, one soil boring (C-1) was installed at the midpoint of the eastern side of the tank. This boring was advanced to just below the backfill/natural soil interface of 15.5 feet. Samples were collected from the base of the backfill material and from the natural soils immediately underlying the backfill.

3.5 Background Sample

One boring was advanced in an area immediately to the east of the parking area to the east of the plant. The location of the background sample is in an area outside of the normal plant operating areas and is believed to be representative of natural conditions. The boring was advanced to a depth of 4.0 feet and a single soil sample was obtained.

4.0 PROJECT FINDINGS AND INTERPRETATION

4.1 Physical Setting and Geology

The former AWI facility is located in a predominantly rural area. The property is bounded by agricultural land to the north, a distributor/maintenance garage and wooded land to the east, County Route 28 to the south, and Central Hudson Electric and Gas Company property to the west.

The predominant soils in the vicinity of the property consist of dark brown to dark gray clay and silty clay. According to a local driller, the clay unit is areally extensive around Athens, and extends to the shale bedrock that is present at depths of between 60 and 100 feet. The clay unit does not produce water in volumes sufficient for any type of groundwater usage.

The nearest surface water body is Murderers Creek, which is located approximately 1.6 miles to the north of the facility. A NYSDEC-designated wetland is reportedly located between the facility and Murderers Creek.

4.2 Site Stratigraphy

Soil sampling activities indicated that the depth of fill materials overlying the native clay varied between 2.0 and 15.5 feet. Figure 2 present s a generalized cross-section showing the sampling points relative to the depths of the adjacent process units being investigated. This cross-section indicates that the sampling points were appropriately located to identify the potential presence of releases from these units. Further, the cross-section indicates that the excavation cavity for the former effluent tank would tend to serve as a "sump" that would likely collect any releases of CCA solution from the North and South Sumps, as well as releases from the tank itself and its associated piping.

4.3 Soil Quality

Analytical results for the soil sampling programs are summarized in Table 1, and the laboratory data packages are included as Attachment B.

Representative concentrations of wood preservative materials that would be present in the sumps and on the drip pad, and that would have been present in the former effluent tank/piping system, are as follows:

Arsenic	up to 20,000 ppm
Total Chromium	up to 25,000 ppm
Hexavalent Chromium	up to 20,000 ppm

A review of Table 1 indicates that the constituents of interest were detected at concentrations that were notably above the background soil concentrations in at least one sample collected from each unit investigated. Hexavalent chromium, which is considered to be an indicator parameter for the CCA wood preservative, was not detected in samples collected from the vicinity of the other units investigated. However, the maximum concentration of hexavalent chromium detected (42 mg/kg in Sample C-10 Fill in the "North Sump") is well below the concentration that would be expected in the event of a release of wood preservative solution. Similarly, the highest concentrations of arsenic and total chromium that were detected in the investigation (911 mg/kg in Sample C-14 and 730 mg/kg in Sample C-12, respectively) are substantially below the concentrations that would be expected in the event of a release of wood preservative from the units.

A comparison between the fill material and clay material soil quality data indicates that the constituent concentrations in the underlying clay unit are generally lower than the concentrations found in the overlying fill materials. Hexavalent chromium concentrations were low to non-detect for all samples collected. These results suggest that the constituents of interest have not migrated into the underlying clay unit from the fill unit.

4.4 Characterization of Potential Risks

The concentrations of the constituents of interest in the fill unit were further evaluated to determine whether they pose a potential risk to human health. For this evaluation, the potential for exposure to industrial workers in the event that these subsurface soils become exposed was examined. This is believed to be a highly conservative scenario, given the active nature of the facility and the subsurface/covered nature of the fill materials in question. Because of the thickness, lateral extensiveness, and inability to provide groundwater in appreciable quantities of the underlying clay unit, the potential mobility of constituents of interest and the resultant potential for exposures are low. As a result, the soil-to-groundwater pathway and corresponding groundwater use scenarios were not considered in this risk characterization.

The complete risk characterization is presented in Attachment C. In summary, the results of the risk assessment indicate that theoretical excess lifetime cancer risk for the industrial worker scenario was 8.5×10^{-5} is within the acceptable risk range of 1×10^{-4} to 1×10^{-6}. Similarly, the summed hazard index was 0.53, which is below the target benchmark of 1.0. Since these methodologies used to estimate these potential risks are extremely conservative, adverse health effects would not be expected to occur in workers in the hypothetical future scenario associated with the exposure of the subsurface fill materials containing the constituents of interest.

5.0 SUMMARY AND CONCLUSIONS

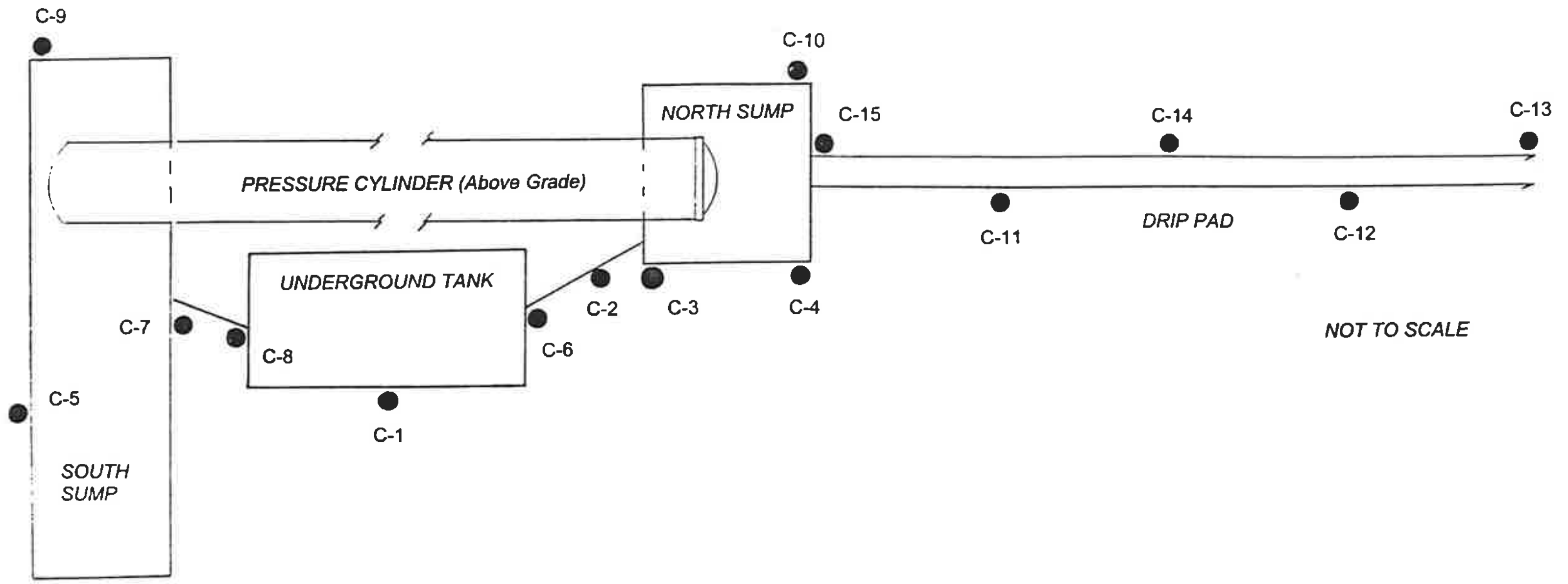
While the results of some of the individual sample analyses from the investigation detected constituent concentrations that were elevated above background soil concentrations, the concentrations detected are not of the magnitude that would be expected in the event of a continuing release of wood preservative solution from any of the units investigated. Rather, if the constituent concentrations detected are related to the operation of the facility, they appear to be attributable to historical operations, where there may have been incidental drippage or *de minimus* releases prior to the expansion of the drip pad. In the early period of facility operation, the majority of the current drip pad and building were not present. As a result, it is likely that incidental releases of wood treating chemicals to the immediately adjacent unpaved areas occurred -- particularly during heavy rainfall and snow events. The facility operating practices during this period were in full compliance with applicable regulations of the time. Since that time, an industry-wide upgrade of environmental practices and increasingly more stringent regulations have resulted in a higher level of containment as currently in place at this facility.

The presence of the detected constituents in the fill unit is not of significance from a fate-and-transport perspective. The majority of the sample locations are paved and under roof, and are therefore isolated from precipitation infiltration. Further, data from the underlying clay materials and information regarding the permeability and thickness of the clay unit indicates that the constituents have not migrated in/through the clay unit . Finally, the lateral extensiveness and vertical thickness (60 to 100 feet) of the clay unit precludes migration of the constituents in groundwater.

The presence of the detected constituents in the fill unit is also not of significance from a human health perspective. The results of a risk assessment performed using these data indicate that the theoretical excess lifetime cancer risk and hazard index for the future industrial worker in the event that the subsurface fill materials containing the constituents of interest are exposed are within acceptable risk limits.

TABLE 1
ANALYTICAL RESULTS -- ATHENS, NEW YORK
NOVEMBER 1998 SOIL SAMPLING ACTIVITIES

Location	Depth Interval (ft.)	Soil Material	Arsenic (mg/kg)	Total Chromium (mg/kg)	Hexavalent Chromium (mg/kg)
Background					
C-B	3.5 - 4.0	Clay	6.6	29	<2.5
South Sump					
C-5	4.5 - 5.5	Fill	7.5	39.9	<2.4
C-7	6.5 - 7.0	Fill	70.9	46.5	<2.2
C-7	7.0 - 7.5	Clay	10.6	41.8	<2.6
C-9	7.0 7.5	Fill	50.9	29.8	<2.1
C-9	7.5 - 8.0	Clay	6.7	36.9	<2.6
North Sump					
C-4	6.25 - 6.5	Fill	246	155	10
C-4	7.0 - 7.5	Clay	6.2	40.5	3.4
C-14	1.5 - 2.0	Fill	911	120	30.5
C-14	2.0 - 2.5	Clay	23.8	48.8	<2.6
C-10	7.0 - 7.5	Fill	404	312	42
C-10	7.5 - 8.0	Clay	21.3	348	4.3
Drip Pad					
C-11	2.5 - 3.0	Fill	74.1	21.4	<2.1
C-11	3.0 - 3.5	Clay	10.8	42.8	<2.5
C-15	2.5 - 3.0	Fill	75	28.3	3.4
C-15	3.0 - 3.5	Clay	8.5	40.8	<2.5
C-12	2.0 - 2.5	Fill	9.2	730	<2.1
C-12	2.5 - 3.0	Clay	41.7	108	<2.5
C-13	1.5 - 2.0	Fill	71.7	84.7	3.8
C-13	2.0 - 2.5	Clay	6.9	32.8	<2.5
Underground Tank					
C-1	14.5 - 15.5	Fill	5.4	22.3	<2.5
C-1	15.5 - 16.0	Clay	8.6	34.2	<2.8
C-2	4.5 - 5.0	Fill	192	229	17.6
C-2	5.0 - 5.5	Clay	28.6	79.1	<2.6
C-3	4.25 - 4.5	Fill	662	580	21.6
C-3	4.5 - 5.25	Clay	22.1	47	<2.7
C-6	13.5 - 14.0	Fill	16	41.9	<2.4
C-6	14.0 - 14.5	Clay	8.5	42.5	<2.7
C-8	6.0 - 6.5	Fill	25.2	99	3.5
C-8	6.5 - 7.0	Clay	9.5	36.4	<2.7



NOT TO SCALE

FIGURE 1
SAMPLING LOCATIONS

Former Atlantic Wood Industries, Inc. Facility
Athens, New York

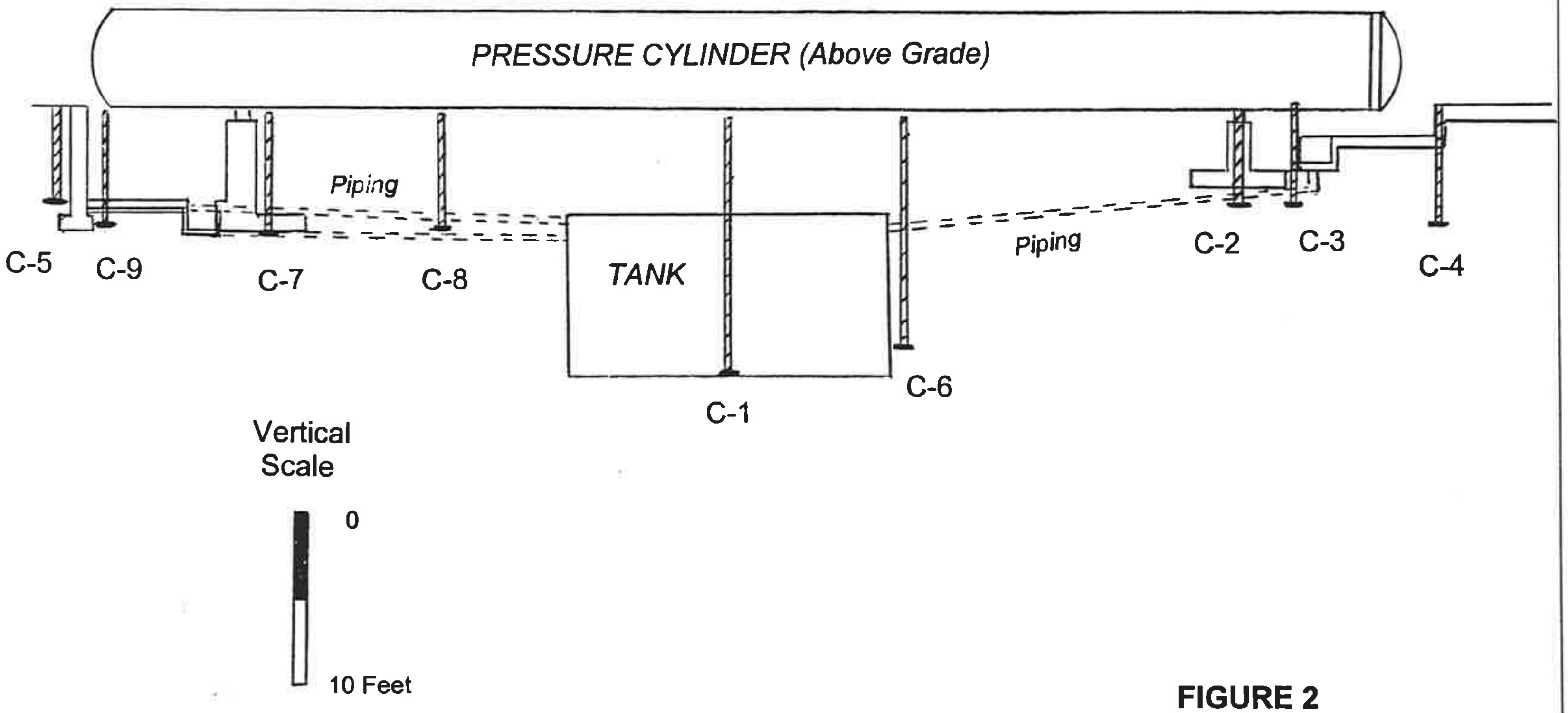


FIGURE 2
SAMPLE DEPTH PROFILES

Former Atlantic Wood Industries, Inc. Facility
Athens, New York

ATTACHMENT A

REPORT OF FINDINGS
CCA SOLUTION RECYCLE SUMP INTEGRITY EVALUATION
AUGUST 1997

REPORT OF FINDINGS
CCA SOLUTION RECYCLE SUMP (SWMU 3) INTEGRITY EVALUATION
FORMER ATLANTIC WOOD INDUSTRIES FACILITY
ATHENS, NEW YORK
EPA I.D. NO. NYD095240610

AUGUST 1997

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REPORT OF FINDINGS
CCA SOLUTION RECYCLE SUMP (SWMU 3) INTEGRITY EVALUATION
FORMER ATLANTIC WOOD INDUSTRIES FACILITY
ATHENS, NEW YORK
EPA I.D. NO. NYD095240610

INTRODUCTION

In the Final Report for the Corrective Action Prior to Loss of Interim Status (CAPTLOIS) inspection conducted at the Athens facility by A.T. Kearney (a contractor to U.S. EPA), it was noted that "the bottom of the CCA Solution Recycle Sump could not be inspected during the site visit since it contained CCA Solution." The Report goes on to recommend that the sump be inspected for integrity, and "should the inspection reveals (sic) cracks or other deterioration, soil sampling is recommended. The soil sampling should include arsenic and chromium."

The CCA (chromated copper arsenate) Solution Recycle Sump (identified by the contractor as SWMU 3) measures approximately 36 feet long by 8.5 feet wide, and is approximately six feet deep. The CCA Solution Recycle Sump is entirely under roof, and partially located along an outside wall of the facility building.

This Sump has remained in use at the facility, resulting in the continued inability to thoroughly inspect the bottom and interior surfaces to evaluate Sump integrity. As a result, KU Resources, Inc. collected soil samples in the vicinity of this Sump, with the intent of demonstrating Sump integrity through soil quality data.

SAMPLING RATIONALE

The collection of samples through the bottom of the Sump was not attempted, due to access difficulties and the possibility of destroying the long-term integrity of the Sump bottom. Rather, it was felt that the collection of samples of natural soils from immediately adjacent to and below the base of the Sump would provide representative data to evaluate the potential for releases from this unit. It is our understanding that the Sump was constructed by excavating a pit into natural cohesive soils, placing granular backfill as a base of the concrete sump floor, and pouring the sump floor/wall structures. Any releases of liquids contained in the Sump would be expected to enter the granular backfill and ultimately spread throughout that backfilled area. As a result, samples collected from areas immediately adjacent to the Sump would be expected to encounter affected soil if such a release has occurred.

Given the nature of the wood preservative materials contained by the Sump, the samples were analyzed for arsenic, total chromium, and hexavalent chromium. Hexavalent chromium was included in the analytical suite as a primary indicator of the presence of the wood preservative. Arsenic and total chromium, while present in the wood preservative, could also be expected to be detected at ambient (background) concentrations in soils under natural conditions, unaffected by plant operations. Hexavalent chromium, on the other hand, would not be expected to be detected in soils under natural conditions.

SOIL SAMPLING AND ANALYSIS

Soil sampling was performed by Nittany Geoscience, Inc. of State College, Pennsylvania. Samples were collected using direct-push sampling equipment, driven by a van-mounted Geoprobe® sampling unit where access was available, and driven by a pneumatic jackhammer where van access was not available. Soil samples were collected in new four-foot acetate liners placed inside of the direct-push sampling tubes. All down-hole equipment was decontaminated between samples.

Soil samples were collected from a total of nine borings (B-1 through B-9) surrounding the CCA Solution Recycle Sump. These boring locations are shown on Figure 1. The borings were placed as close to the Sump as practicable, given physical constraints presented by overhead structures, at-grade structures and equipment, and subsurface utilities and foundations, as also shown on Figure 1. In all but three of the boring locations, this resulted in the borings being placed within two feet of the edge of the Sump. For the locations inside the building, the building's concrete floor slab was cored to provide access to the underlying soil.

One representative background soil sample of non-fill materials was also collected from a boring (BK-1) located in an area away from the wood preserving operations area. The boring location is 95 feet to the northeast of the boring B-2 location shown on Figure 1. The background soil sample was collected in natural soils, at a depth interval of five to six feet below grade. This corresponded to the depth interval sampled by the eight borings surrounding the Sump.

Sampling equipment was advanced to a depth beneath the base of the sump. The samples were collected from the natural (non-fill) soils, at depths below the level of the base of the Sump. Upon collection and removal from the acetate sampling tube liners, the samples were examined by the field geologist, and logged accordingly.

Following completion of sampling, boreholes were backfilled with bentonite hole-plug. For the boring locations inside the building, the concrete slab was patched following borehole backfilling.

Soil samples were submitted under chain-of-custody protocols via overnight express for analysis. Analyses were performed by Centre Analytical Laboratories, Inc. of State College, PA for total chromium, hexavalent chromium, and arsenic.

PROJECT FINDINGS

Soil sampling activities indicated that, in the vicinity of the CCA Solution Recycle Sump, approximately five feet of fill materials overlie the native clay. Analytical results for the soil sampling program are summarized in Table 1, and the laboratory data package is included as Attachment A. Arsenic and hexavalent chromium concentrations in the native clay beneath the base of the Sump are below detection limits for all samples. Total chromium was detected in all samples, including the sample considered as being representative of background conditions. Concentrations of total chromium in the native clay for samples collected from around the Sump were similar to the concentration of total chromium detected in the background sample.

SUMMARY AND CONCLUSIONS

Soil sampling and analytical work were performed at the former Atlantic Wood Industries facility in Athens, New York to evaluate the integrity of the CCA Solution Recycle Sump. Soil borings were conducted at eight locations around the Sump, in close proximity to the Sump, and samples of the native clay soils immediately beneath the level of the base of the Sump were submitted for analysis. In addition, a sample from a similar depth interval in a background location was collected and submitted for analysis. Analytical results were non-detect for arsenic and hexavalent chromium at all locations sampled. Total chromium concentrations in the vicinity of the Sump were similar to the total chromium concentration detected in the background sample.

As a result of these investigative activities, it has been demonstrated that CCA wood preservatives have not been released into the native clay soils immediately underlying the Sump. Given the physical setting of the Sump, it can therefore be further concluded that the integrity of the Sump structure is sufficient to prevent releases of wood preservative solution in the Sump.

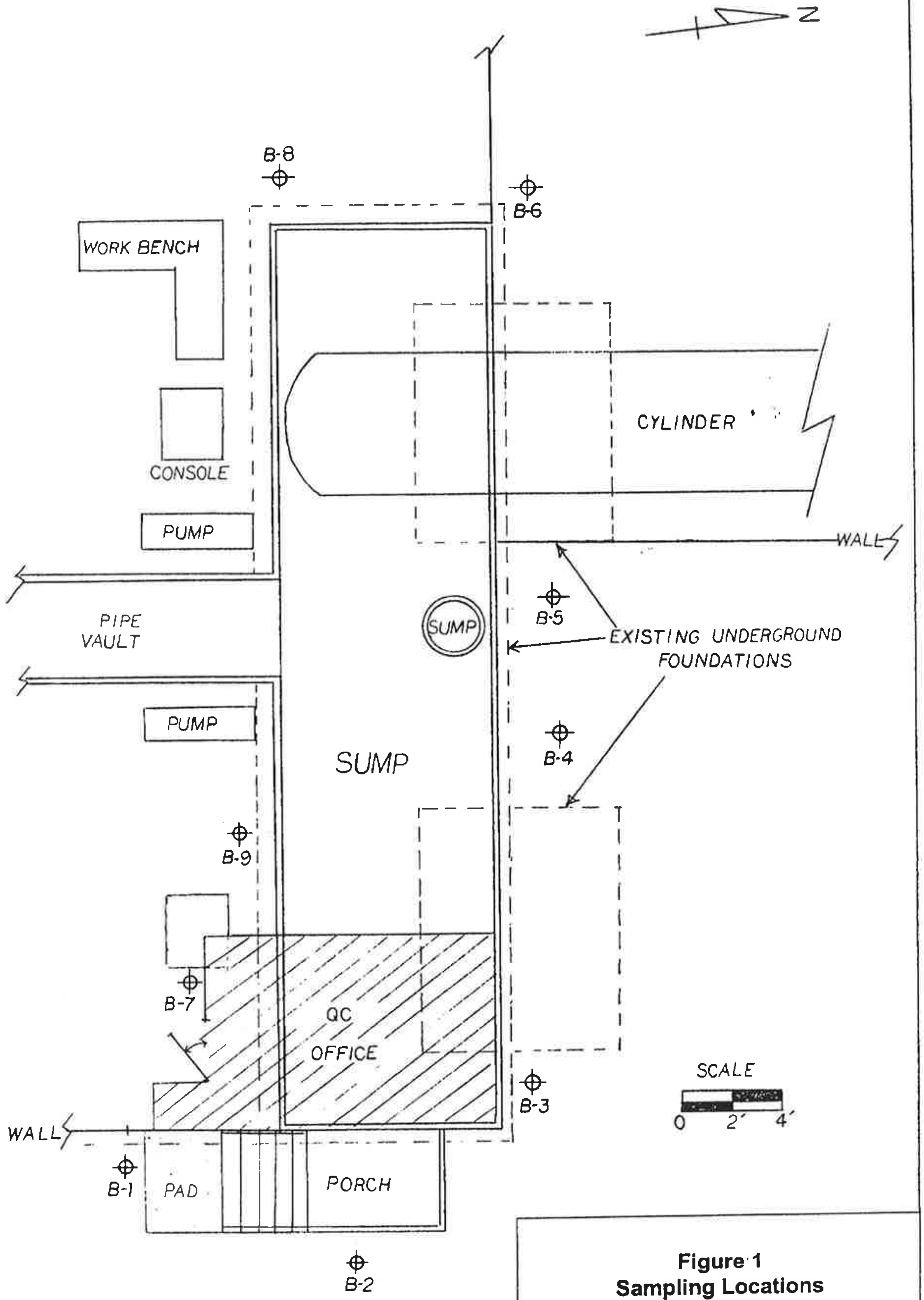

Figure 1
Sampling Locations
former
Atlantic Wood Industries, Inc.
Athens, NY

TABLE 1
Summary of Results (all results in mg/kg)
Northeast Treaters, Athens, New York

	BK-1	B-3	B-4	B-5	B-2	B-1	B-9	B-7	B-6	B-8
Arsenic	< 2.85	< 2.9	< 2.88	< 2.82	< 2.87	< 2.87	<3.25	< 2.95	< 2.95	< 2.86
Chromium	24	25.9	29	23.8	28.6	25.5	24.5	27.5	32.7	42.3
Hexavalent Chromium	< 4.98	< 5.23	< 5.37	< 5.26	<5.47	< 5.16	< 5.27	< 5.24	< 5.18	< 4.9

ATTACHMENT A

LABORATORY DATA PACKAGE

ANALYTICAL REPORT

Centre Analytical Laboratories, Inc.

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Page: 1

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number: 165

Contact: SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID: BK-1

Lab ID: L15119-1

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
HEXAVALENT CHROMIUM	mg/kg(dry)	< 4.98	4.98	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg(dry)	< 2.85	2.85	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg(dry)	24	57	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	78.63	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

Please refer to the reverse side for our standard terms and conditions.

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number: 165

Contact: SHANA TRITSCH

Date Received: 18-JUN-97
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Date Collected: 17-JUN-97

Client ID: B-1

Lab ID: L15119-6

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYS
HEXAVALENT CHROMIUM	mg/kg(dry)	< 5.16	5.16	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg(dry)	< 2.87	2.87	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg(dry)	25.5	.575	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	77	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number: 165

Contact: SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID: B-2

Lab ID: L15119-5

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
HEXAVALENT CHROMIUM	mg/kg(dry)	< 5.47	5.47	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg(dry)	< 2.87	2.87	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg(dry)	28.6	.574	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	73.86	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs. Inc.
Reviewed and Approved by:

Kevin J Lloyd
Laboratory Supervisor

ANALYTICAL REPORT

Centre Analytical Laboratories, Inc.
3048 Research Drive, State College PA 16801 814-231-8032 FAX 814-231-1253

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number 165

Contact SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number. 14414

Date Collected: 17-JUN-97

Client ID B-1

Lab ID L15119-2

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYS
HEXAVALENT CHROMIUM	mg/kg(dry)	< 5.23	5.23	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg(dry)	< 2.0	2.0	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg(dry)	25.3	.541	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	74.25	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

Centre Analytical Laboratories, Inc.

3048 Research Drive. State College PA 16801 814-231-8032 FAX 814-231-1253

Page: 3

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number 165

Contact. SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID B-4

Lab ID [illegible]

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYS
HEXAVALENT CHROMIUM	mg/kg dry	< 5.37	5.37	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg dry	< 2.39	2.39	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg dry	23	.576	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	72.0	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

Please refer to the reverse side for our standard terms and conditions.

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number: 165

Contact: SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID: B-5

Lab ID: L15113-4

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYS
HEXAVALENT CHROMIUM	mg/kg(dry)	< 5.26	5.26	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg(dry)	< 2.82	2.82	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg(dry)	23.3	.563	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	76.2	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by

[illegible]
[illegible]

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number: 165

Contact: SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID: B-6

Lab ID: L15119-10

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
HEXAVALENT CHROMIUM	mg/kg(dry)	< 5.18	5.18	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg(dry)	< 2.95	2.95	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg(dry)	32.7	.591	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	76.97	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs. Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number: 165

Contact: SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID: B-7

Lab ID: L15119-8

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYS
HEXAVALENT CHROMIUM	mg/kg(dry)	< 5.24	5.24	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg(dry)	< 2.95	2.95	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg(dry)	27.5	.589	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	75.43	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

ANALYTICAL REPORT

Centre Analytical Laboratories, Inc.

3048 Research Drive, State College PA 16801 814-231-8032 FAX 814-231-1253

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number 168

Contact SHANA TRITSCH

Date Received: 18-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID: B-4

Lab ID [illegible]

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
HEXAVALENT CHROMIUM	mg/kg dry	< 4.3	4.3	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg dry	< 2.36	2.36	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg dry	42.1	.472	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	78.21	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc
Reviewed and Approved by

[illegible]

Centre Analytical Laboratories, Inc.

3048 Research Drive. State College PA 16801 814-231-8032 FAX 814-231-1253

Page:

NITTANY GEOSCIENCE INC
120 RADNOR ROAD
STATE COLLEGE , PA 16801
Account Number: 165

Contact SHANA TRITSCH

Date Received: 16-JUN-97
Date Reported: 24-JUN-97

Invoice Number: 14414

Date Collected: 17-JUN-97

Client ID: B-9

Lab ID: 115117

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALY
HEXAVALENT CHROMIUM	mg/kg dry	< 5.27	5.27	EPA 7196	18-JUN-97	GAF
METALS ANALYSIS						
ARSENIC-TOTAL	mg/kg dry	< 3.35	3.35	EPA 6010	19-JUN-97	JWH
CHROMIUM-TOTAL	mg/kg dry	24.5	.67	EPA 6010	19-JUN-97	JWH
PERCENT SOLIDS	%	77.7	.01	SM 2540A	19-JUN-97	JWH

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no. BK-1	Sheet 1 of 1
Sample name BK-1	

NGS Project Number 272-004
Project Location Northeast Treaters, Athens, NY
Operator C. Rockwell
Geologist S. Tritsch

Sampling location

See Figure

Sampling Method Geoprobe
Headspace analysis method None
Depth to water

Boring Start	Boring Finish
Time 0750	Time 0815
Date 6/17/97	Date 6/17/97

Surface conditions, other comments

Gravel and grass
Cloudy 60°

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	4	100	CH	10" topsoil		
					Brown varved clay (hard, medium plasticity)		
4	8	4	100	CH	Same as above	X	
					Sampled from 5-6'		
					Arsenic and Total Cr 5.-5.5		
					Hex Cr 5.5-6		

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

NGS Project Number	272-004
Project Location	Northeast Treaters, Athens, NY
Operator	C. Rockwell
Geologist	S. Tritsch

Boring no. B-1	Sheet 1	of 1
Sample name B-1		

Sampling location

See Figure

Sampling Method: Geoprobe	Boring Start	Boring Finish
	Time 1130	Time 1150
Headspace analysis method: None		
	Date 6/17/97	Date 6/17/97
Depth to water: Unknown		

Surface conditions, other comments

Hard gravel

Cloudy 65°

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	1.5			Black sand and gravel fill		
					Bottom 0.5' brown clay		
4	8	4			Hard brown clay	X	
					Sample 5.5-6.5		

Im 07/logs GeoprobeS.B.Log

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no. B-2	Sheet 1 of 1
Sample name B-2	

NGS Project Number	272-004
Project Location	Northeast Treaters, Athens, NY
Operator C. Rockwell	Geologist S. Tritsch

Sampling location

See Figure

Sampling Method Geoprobe

Headspace analysis method None

Depth to water

Boring Start	Boring Finish
Time 1050	Time 1115
Date 6/17/97	Date 6/17/97

Surface conditions, other comments

Gravel

Cloudy 60°

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS class	Description of material and remarks	Sample collected	PID meas. (ppm) total
0	4	1.8		GW-SW	Black sand-gravel fill		
				CH	Bottom 0.4' hard brown clay		
4	8	4			Hard brown varved clay	X	
					Sample from 5.5-8		

D7/mgs Geoprobe5.8 Log

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no.	B-3
Sheet 1 of 1	
Sample name	B-3

NGS Project Number	272-004
Project Location	Northeast Treaters, Athens, NY
Operator	C. Rockwell
Geologist	S. Tritsch

Sampling location

See Figure

		Boring Start	Boring Finish
Sampling Method	Geoprobe	Time 0900	Time 0930
Headspace analysis method	None	Date 6/17/97	Date 6/17/97
Depth to water			

Surface conditions, other comments

Gravel

Raining 60°

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	1.5		GW-SW	Black sand and gravel fill		
					Bottom 6' wet		
		2.7			Top 1.2' Same as above, possible fall in		
					Hard clay below	X	
					Sample for arsenic and total chromium 5.2-5.8		
					Hex chromium 5.8-6.2' bgs		

07/mga Geoprobe5.8 Log

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no. B-4	Sheet 1 of 1
Sample name B-4	

NGS Project Number	272-004
Project Location	Northeast Treaters, Athens, NY
Operator C. Rockwell	Geologist S. Tritsch

Sampling location

See Figure

Sampling Method Geoprobe	Boring Start	Boring Finish
	Time 0930	Time 1000
Headspace analysis method None	Date 6/17/97	Date 6/17/97
Depth to water		

Surface conditions, other comments

Gravel, flat

Raining 60°

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	1.7		CH	0.9' fill		
					Hard brown and gray clay		
4	8	4		CH	Hard brown and gray (30%) clay	X	
					5.5-6.9 Hex chromium		
					5.9-6.4 arsenic and chromium		

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no. B-5	Sheet 1 of 1
Sample name B-6	

NGS Project Number 272-004	
Project Location Northeast Treaters, Athens, NY	
Operator C. Rockwell	Geologist S. Tritsch

Sampling location

See Figure

	Boring Start	Boring Finish
Sampling Method Geoprobe	Time 1015	Time 1040
Headspace analysis method None	Date 6/17/97	Date 6/17/97
Depth to water		

Surface conditions, other comments

Gravel, flat

Raining 60°

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	0.4			Black gravel-sand fill		
4	8	1.8			Top 1' black fill, possibly fall-in		
					Arsenic chromium bottom 6" and 6.5-7'	X	
					Hex chromium 7-7.5		

ts.07/ngs.Geoprobe5.B.Log

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no. B-6	Sheet 1 of 1
Sample name B-6	

NGS Project Number	272-004
Project Location	Northeast Treaters, Athens, NY
Operator C. Rockwell	Geologist S. Tritsch

Sampling location

See Figure

Sampling Method Handprobe

Headspace analysis method None

Depth to water

Boring	
Start	Finish
Time 1440	Time 1520
Date 6/17/97	Date 6/17/97

Surface conditions, other comments

6" Concrete
Inside building
Cloudy 60s

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	1	25	SW-GW	Black sand and gravel fill		
4	7	2.92	100	CH	Brown varved clay	X	
					Sampled from 5-6'		

te.07/ngL.Geoprobe5.B Log

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no. B-7
Sheet 1 of 1
Sample name B-7

NGS Project Number 272-004
Project Location Northeast Treaters, Athens, NY
Operator C. Rockwell
Geologist S. Tritsch

Sampling location
See Figure

Sampling Method Handprobe
Headspace analysis method None
Depth to water

	Boring start	Boring finish
Time	1415	1420
Date	6/17/97	6/17/97

Surface conditions, other comments
6" Concrete
Cloudy 65°

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS class	Description of material and remarks	Sample collected	PID meas. (ppm) total
0	4	2.5		CH	0.5' fill		
					Gray brown hard medium plasticity clay		
4	7	27		CH	Same as above, wet brown gray	X	
					Hex Cr 5-5.5		
					Cr As 5.5-6.0		

Ise.97/ngs GeoprobeS.B.Log

NITTANY GEOSCIENCE INC.

Geoprobe Soil Boring Log

Boring no. B-8	Sheet 1 of 1
Sample name B-8	

NGS Project Number	272-004
Project Location	Northeast Treaters, Athens, NY
Operator	C. Rockwell
Geologist	S. Tritsch

Sampling location

See Figure

Sampling Method Handprobe

Headspace analysis method None

Depth to water

Boring	Start	Finish
Time	1530	1550
Date	6/17/97	6/17/97

Surface conditions, other comments

Pavement inside building

Cloudy 60

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	0.5	13	SW-GW	Black sand and gravel fill		
4	7	3	100	CH	Hard gray/brown clay	X	
					Sampled from 5-6'		

les 07/mgs Geoprobe S.B.Log

NITTANY GEOSCIENCE INC.

Geoprobe® Soil Boring Log

Boring no. B-9	Sheet 1 of 1
Sample name B-9	

NGS Project Number	272-004
Project Location	Northeast Treaters, Athens, NY
Operator C. Rockwell	Geologist S. Tritsch

Sampling location

See Figure

Sampling Method Handprobe	Boring Start Time 1330	Boring Finish Time 1400
Headspace analysis method None	Date 6/17/97	Date 6/17/97
Depth to water		

Surface conditions, other comments

6" Concrete

Depth (feet) From	Depth (feet) To	Recovery in feet	Recovery in %	USCS abbrev.	Description of material and remarks	Sample collected	PID meas. (ppm) Total
0	4	1.2			Black sand-gravel fill-wet		
4	8	3		CH	Top 1' fill		
					Gray wet clay, medium plasticity	X	
					Hex Cr 5.5-6		
					Cr Arsenic 5-5.5		

fm.07ngs. GeoprobeS.B Log

ATTACHMENT B

ANALYTICAL DATA
NOVEMBER 1998 FIELD SAMPLING PROGRAM

Report of Analysis

Client Sample ID:	C1 14.5-15.5		
Lab Sample ID:	E42068-1	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	79.9
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	5.4	1.2	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B
Chromium	22.3	1.2	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B

RDL = Reported Detection Limit

ACCUTEST

Report of Analysis

Client Sample ID: C1 14.5-15.5
Lab Sample ID: E42068-1
Matrix: SO - Soil

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 79.9

Project: AWI-Athens, NY

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.5	2.5	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	79.9		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C1 15.5-16.0		
Lab Sample ID:	E42068-2R	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	71.2
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	8.6	1.4	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	34.2	1.4	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

ACCUTEST®

Report of Analysis

Client Sample ID:	C1 15.5-16.0		
Lab Sample ID:	E42068-2R	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	71.2
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.8	2.8	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	71.2		%	1	12/17/98	DM	EPA 160.3 M

4

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C2 4.5-5.0		
Lab Sample ID:	E42068-3	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	83.7
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	192	1.2	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B
Chromium	229	1.2	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C2 4.5-5.0
Lab Sample ID: E42068-3
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 83.7

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	17.6	2.4	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	83.7		%	1	11/19/98	DM	EPA 160.3 M

7

RDL = Reported Detection Limit

ACCUTEST

Report of Analysis

Client Sample ID: C2 5.0-5.5
Lab Sample ID: E42068-4R
Matrix: SO - Soil

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 75.7

Project: AWI-Athens, NY

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	28.6	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	79.1	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

5

RDL = Reported Detection Limit

ACCUTEST

Report of Analysis

Client Sample ID:	C2 5.0-5.5		
Lab Sample ID:	E42068-4R	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	75.7
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.6	2.6	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	75.7		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C3 4.25-4.5
Lab Sample ID: E42068-5
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 82.0

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	662	1.2	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B
Chromium	580	1.2	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C3 4.25-4.5
Lab Sample ID: E42068-5
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 82.0

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	21.6	2.4	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	82		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

ACCUTEST

Report of Analysis

Client Sample ID: C3 4.5-5.25
Lab Sample ID: E42068-6R
Matrix: SO - Soil
Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 74.5

Project: AWI-Athens, NY

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	22.1	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	47.0	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C3 4.5-5.25	**Date Sampled:**	11/12/98
Lab Sample ID:	E42068-6R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	74.5
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.7	2.7	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	74.5		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C-4 6.25-6.5		
Lab Sample ID:	E42068-30	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	85.9
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	246	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	155	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

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RDL = Reported Detection Limit

ACCUTEST.

Report of Analysis

Client Sample ID: C-4 6.25-6.5
Lab Sample ID: E42068-30
Matrix: SO - Soil
Project: AWI-Athens, NY

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 85.9

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	10.0	2.3	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	85.9		%	1	11/19/98	DM	EPA 160.3 M

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RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C4 7'-7.5'		
Lab Sample ID:	E42068-7	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	78.6
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	6.2	1.3	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B
Chromium	40.5	1.3	mg/kg	1	11/20/98	11/24/98	MFH	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C4 7'-7.5'	**Date Sampled:**	11/12/98
Lab Sample ID:	E42068-7	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	78.6
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	3.4	2.5	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	78.6		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C5 4.5-5.5		
Lab Sample ID:	E42068-8	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	83.5
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	7.5	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	39.9	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C5 4.5-5.5		
Lab Sample ID:	E42068-8	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	83.5
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.4	2.4	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	83.5		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C6 13.5-14.0		
Lab Sample ID:	E42068-9	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	84.1
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	16.0	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	41.9	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C6 13.5-14.0		
Lab Sample ID:	E42068-9	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	84.1
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.4	2.4	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	84.1		%	1	11/19/98	DM	EPA 160.3 M

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RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID:	C6 14.0-14.5	**Date Sampled:**	11/12/98
Lab Sample ID:	E42068-10R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	72.8
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	8.5	1.4	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	42.5	1.4	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C6 14.0-14.5
Lab Sample ID: E42068-10R
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 72.8

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.7	2.7	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	72.8		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C7 6.5-7.0
Lab Sample ID: E42068-12
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/12/98
Date Received: 11/16/98
Percent Solids: 91.2

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	70.9	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	46.5	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C7 6.5-7.0		
Lab Sample ID:	E42068-12	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	91.2
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.2	2.2	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	91.2		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

ACCUTEST

Report of Analysis

Client Sample ID:	C7 7.0-7.5		
Lab Sample ID:	E42068-13R	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	75.7
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	10.6	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	41.8	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID:	C7 7.0-7.5	**Date Sampled:**	11/12/98
Lab Sample ID:	E42068-13R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	75.7
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.6	2.6	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	75.7		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID:	C8 6.0-6.5		
Lab Sample ID:	E42068-14	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	83.3
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	25.2	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	99.0	1.2	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

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RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C8 6.0-6.5		
Lab Sample ID:	E42068-14	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	83.3
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	3.5	2.4	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	83.3		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C8 6.5-7.0		
Lab Sample ID:	E42068-15R	**Date Sampled:**	11/12/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	74.5
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	9.5	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	36.4	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID:	C8 6.5-7.0	**Date Sampled:**	11/12/98
Lab Sample ID:	E42068-15R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	74.5
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.7	2.7	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	74.5		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C9 7.0-7.5		
Lab Sample ID:	E42068-16	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	93.4
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	50.9	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	29.8	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C9 7.0-7.5		
Lab Sample ID:	E42068-16	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	93.4
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed By	Method
Chromium, Hexavalent	<2.1	2.1	mg/kg	1	12/01/98 MET	SW846 3060A/7196A
Solids, Percent	93.4		%	1	11/19/98 DM	EPA 160.3 M

RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID:	C9 7.5-8.0		
Lab Sample ID:	E42068-17R	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	78.2
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed By	Method
Arsenic	6.7	1.3	mg/kg	1	12/17/98	12/17/98 BB	SW846 6010B
Chromium	36.9	1.3	mg/kg	1	12/17/98	12/17/98 BB	SW846 6010B

RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID:	C9 7.5-8.0		
Lab Sample ID:	E42068-17R	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	78.2
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.6	2.6	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	78.2		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C10 7.0-7.5		
Lab Sample ID:	E42068-18	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	90.0
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	404	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	312	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

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RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C10 7.0-7.5		
Lab Sample ID:	E42068-18	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	90.0
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	42.0	2.2	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	90		%	1	11/19/98	DM	EPA 160.3 M

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RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C10 7.5-8.0	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-19R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	76.9
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	21.3	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	348	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C10 7.5-8.0
Lab Sample ID: E42068-19R
Matrix: SO - Soil
Date Sampled: 11/13/98
Date Received: 11/16/98
Percent Solids: 76.9

Project: AWI-Athens, NY

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	4.3	2.6	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	76.9		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C11 2.5-3.0		
Lab Sample ID:	E42068-20	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	94.3
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	74.1	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	21.4	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

ACCUTEST.

Report of Analysis

Client Sample ID:	C11 2.5-3.0		
Lab Sample ID:	E42068-20	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	94.3
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.1	2.1	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	94.3		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID: C11 3.0-3.5
Lab Sample ID: E42068-21R
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/13/98
Date Received: 11/16/98
Percent Solids: 78.8

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	10.8	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	42.8	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

ACCUTEST

Report of Analysis

Client Sample ID:	C11 3.0-3.5	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-21R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	78.8
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.5	2.5	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	78.8		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID: C12 2.0-2.5
Lab Sample ID: E42068-22
Matrix: SO - Soil
Date Sampled: 11/13/98
Date Received: 11/16/98
Percent Solids: 93.3

Project: AWI-Athens, NY

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	9.2	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	730	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C12 2.0-2.5		
Lab Sample ID:	E42068-22	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	93.3
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.1	2.1	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	93.3		%	1	11/19/98	DM	EPA 160.3 M

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RDL = Reported Detection Limit

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Report of Analysis

Client Sample ID:	C12 2.5-3.0	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-23R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	80.9
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	41.7	1.2	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	108	1.2	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C12 2.5-3.0	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-23R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	80.9
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.5	2.5	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	80.9		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C13 1.5-2.0		
Lab Sample ID:	E42068-24	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	94.0
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	71.7	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	84.7	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C13 1.5-2.0		
Lab Sample ID:	E42068-24	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	94.0
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	3.8	2.1	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	94		%	1	11/19/98	DM	EPA 160.3 M

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RDL = Reported Detection Limit

ACCUTEST.

Report of Analysis

Client Sample ID:	C13 2.0-2.5		
Lab Sample ID:	E42068-25R	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	80.5
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	6.9	1.2	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	32.8	1.2	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

ACCUTEST.

Report of Analysis

Client Sample ID:	C13 2.0-2.5		
Lab Sample ID:	E42068-25R	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	80.5
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.5	2.5	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	80.5		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C14 1.5-2.0		
Lab Sample ID:	E42068-26	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	90.3
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	911	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	120	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

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RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C14 1.5-2.0		
Lab Sample ID:	E42068-26	**Date Sampled:**	11/13/98
Matrix:	SO - Soil	**Date Received:**	11/16/98
		Percent Solids:	90.3
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	30.5	2.2	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	90.3		%	1	11/19/98	DM	EPA 160.3 M

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RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C14 2.0-2.5	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-27R	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	77.2
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	23.8	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	48.8	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C14 2.0-2.5
Lab Sample ID: E42068-27R
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/13/98
Date Received: 11/16/98
Percent Solids: 77.2

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.6	2.6	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	77.2		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	C15 2.5-3.0	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-28	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	93.2
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	75.0	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	28.3	1.1	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

ACCUTEST

Report of Analysis

Page 1 of 1

Client Sample ID:	C15 2.5-3.0	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-28	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	93.2
Project:	AWI-Athens, NY		

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	3.4	2.1	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	93.2		%	1	11/19/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C15 3.0-3.5
Lab Sample ID: E42068-29R
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/13/98
Date Received: 11/16/98
Percent Solids: 79.0

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	8.5	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B
Chromium	40.8	1.3	mg/kg	1	12/17/98	12/17/98	BB	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: C15 3.0-3.5
Lab Sample ID: E42068-29R
Matrix: SO - Soil

Date Sampled: 11/13/98
Date Received: 11/16/98
Percent Solids: 79.0

Project: AWI-Athens, NY

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.5	2.5	mg/kg	1	12/17/98	MET	SW846 3060A/7196A
Solids, Percent	79		%	1	12/17/98	DM	EPA 160.3 M

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID:	CB 3.5-4.0	**Date Sampled:**	11/13/98
Lab Sample ID:	E42068-11	**Date Received:**	11/16/98
Matrix:	SO - Soil	**Percent Solids:**	79.0
Project:	AWI-Athens, NY		

Metals Analysis

Analyte	Result	RDL	Units	DF	Prep	Analyzed	By	Method
Arsenic	6.6	1.3	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B
Chromium	29.0	1.3	mg/kg	1	11/24/98	12/03/98	MMC	SW846 6010B

RDL = Reported Detection Limit

Report of Analysis

Client Sample ID: CB 3.5-4.0
Lab Sample ID: E42068-11
Matrix: SO - Soil

Project: AWI-Athens, NY

Date Sampled: 11/13/98
Date Received: 11/16/98
Percent Solids: 79.0

General Chemistry

Analyte	Result	RDL	Units	DF	Analyzed	By	Method
Chromium, Hexavalent	<2.5	2.5	mg/kg	1	12/01/98	MET	SW846 3060A/7196A
Solids, Percent	79		%	1	11/19/98	DM	EPA 160.3 M

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RDL = Reported Detection Limit

ATTACHMENT C

HUMAN HEALTH RISK ASSESSMENT

ATTACHMENT C
HUMAN HEALTH RISK ASSESSMENT

1.0 INTRODUCTION

This human health risk assessment has been prepared for the former Atlantic Wood Industries, Inc. wood preserving facility, located in Athens, New York. The facility is currently in operation under new ownership. The risk assessment consists of a quantitative analysis of the potential for adverse effects to human health that may be associated with constituents present at the site.

1.1 Purpose of the Risk Assessment

Human health risk assessment is defined as the scientific evaluation of potential health effects posed by a particular substance or mixture of substances. The purpose of this risk assessment is to provide quantitative analyses, in a conservative and health-protective manner, of the likelihood that adverse health effects may be associated with potential exposures to constituents in environmental media at the site. In providing health-related information about potential human contact with site-associated constituents, this risk assessment is designed to provide a sound basis for risk management decisions.

This risk assessment will describe the nature of constituent presence at the site, the possible pathways of human exposure, and the degree to which such exposure may pose a potential for adverse health effects. This document focuses on current and potential future use of the site.

1.2 Regulatory Framework

This risk assessment generally follows standard and customary practice within federal guidelines for the performance of risk assessments (U.S. EPA, 1988, 1989, 1991a, 1992a, 1997). To the extent possible, recent improvements and refinements in the practice of risk assessment have been incorporated into this risk assessment. In addition, relevant guidance from the State of New York has been incorporated as appropriate (NYSDEC, 1994).

1.3 Approach

This risk assessment follows standard and customary United States Environmental Protection Agency (U.S. EPA) guidelines for the performance of risk assessments (U.S. EPA, 1989, 1991a, 1992a, 1997). The scientific basis and validity of values used in this assessment are considered and discussed in the context of primary research literature in order to provide a frame of reference for the conclusions. However, due to regulatory policies which establish the custom of using very conservative assumptions in preparing such risk assessments, the actual levels of human exposure and the potential health risks associated with exposure to constituents at the facility are likely to be lower than the quantitative estimates described in this document.

The organization of this human health risk assessment follows the guidelines published in the U.S. EPA's

Risk Assessment Guidance for Superfund (1989). These guidelines suggest that risk assessments should contain the following four major steps:

- ***Hazard Identification (Identification of Constituents of Interest):*** An evaluation of site investigation data and identification of constituents of interest with regard to potential health effects;
- ***Exposure Assessment:*** Identification of the human receptors likely to be exposed to site-originated constituents and the likely extent of their exposure under defined exposure scenarios;
- ***Dose-Response Assessment (Toxicity Assessment):*** A description of the relationship between the magnitude of exposure (dose) and the probability of occurrence of adverse health effects (response) associated with the constituents of interest; and
- ***Risk Characterization:*** Description of the nature and magnitude of potential human health risks, comparison to federal criteria regarding health risks at hazardous waste sites, and a discussion of uncertainties in the analysis.

1.4 Risk Assessment Organization

This report is organized in a manner consistent with the above-mentioned sections of a risk assessment. The sections of the report are as follows:

- Section 1 provides an introduction to the risk assessment and describes the structure of the report.
- Section 2 provides background information on the site and identifies constituents of interest at the site.
- Section 3 identifies likely human receptors at the site and presents the exposure factors that are used to estimate the extent of exposure for each receptor.
- Section 4 describes the standard procedures for deriving health effects criteria and presents the U.S. EPA health criteria for the constituents of interest.
- Section 5 quantifies and summarizes the potential risks associated with exposure to the constituents of interest.
- Section 6 describes the uncertainties associated with the calculated exposures and potential health risks.
- Section 7 presents the conclusions of the risk assessment.
- Section 8 presents the references cited in the risk assessment.

2.0 IDENTIFICATION OF CONSTITUENTS OF INTEREST

The purpose of this section is to identify the constituents that will be evaluated quantitatively in the risk assessment. This section presents background information and analytical data for the site that were used in the risk assessment. Constituents of interest (COIs) are identified for detailed quantitative evaluation. COIs for human health risk assessment are defined as those constituents present at a site that comprise the major portion of the calculated hazard and risk values.

2.1 Sampling Conducted at the Site

In 1998, fifteen soil samples were collected from the surficial fill unit that overlies an extensive natural clay unit. Other samples were collected from the underlying clay unit, but these samples are not considered relevant to the potential for exposure. The fill unit samples were collected from locations that are largely beneath concrete pavement and under roof, at depths of between 1.5 and 15.5 feet below ground surface. The soil samples were analyzed for arsenic, total chromium, and hexavalent chromium (chromium VI). Table 2-1 presents a list of the samples collected, the depth of each sample, and the analytical results for each constituent analyzed.

2.2 Constituents of Interest

An important step in the risk assessment process is to identify the COIs at a site. COIs are defined by the U.S. EPA as constituents potentially related to the site whose data are of sufficient quality for use in a quantitative risk assessment.

For this facility, arsenic, total chromium, and hexavalent chromium have been identified as COIs. These are the primary constituents associated with the chromated copper arsenate (CCA) wood treating process used at the facility since the start of operations.

Table 2-2 provides a summary of the analytical data for the site, including the frequency of detection, range of detected concentrations, range of detection limits, mean concentration, and the sample number of the maximum detected concentration for each COI.

NYSDEC provides soil cleanup objectives for arsenic and chromium of 7.5 mg/kg and 10 mg/kg, respectively (NYSDEC, 1994). The maximum concentrations of arsenic and total chromium detected in the fill unit sampling program exceed these recommended levels; however, the concentration of hexavalent chromium is below the recommended level. Nevertheless, each of the three constituents will be evaluated in the site-specific, quantitative risk assessment.

3.0 EXPOSURE ASSESSMENT

Exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of human exposure to a constituent in the environment. This section of the risk assessment discusses the mechanisms by which people might come in contact with constituents of interest and the approximate magnitude, frequency, and duration of contact between potential human receptors and the constituents. The quantitative assessment of exposure, based on constituent concentrations and the degree of absorption of each constituent, provides the basis for estimating constituent uptake (dose) and associated health risks. The exposure assessment follows, as much as possible, the recommendations for conducting an assessment according to U.S. EPA risk assessment guidance (1989) and the *Guidelines for Exposure Assessment* (U.S. EPA, 1992a).

3.1 Pathways of Potential Human Exposure

An exposure pathway describes the course that a constituent takes from its environmental source to a human receptor. Each exposure pathway includes the following aspects: 1) a source or constituent release from a source; 2) an exposure medium (e.g., soil); 3) a point of potential contact for the receptor with the exposure medium (e.g., exposed surface soil); and 4) an exposure route at the contact point (e.g., incidental ingestion, dermal contact). An exposure pathway is considered complete when all of these aspects are present. Only complete exposure pathways are evaluated quantitatively in the risk assessment.

3.1.1 Potential Exposure Media and Routes of Exposure

COIs were identified for the fill unit investigated at the facility. It is important to note that the samples were collected from beneath pavement and/or at depth. Therefore, under current conditions, there is no potential for contact with these soils. However, this assessment addresses the hypothetical future case in which these soils could be brought to the surface, where potential direct contact could occur. For receptors with potential to directly contact site soils, incidental ingestion of constituents in soil and dermal contact with constituents in soil are the standard exposure routes which are assessed.

3.1.2 Potential Receptors

The potential human receptors at a site must be characterized in order to evaluate potential exposure pathways. Potential receptors for the site are identified based on the assumptions that current and future land use is industrial.

The site is currently active, and the only potential receptors expected to be present are industrial workers. However, as stated previously, under current conditions, there is no potential for subsurface soil contact. Under hypothetical future conditions, if soils are brought to the surface due to excavation activities, a worker may contact these soils. Therefore, this assessment evaluates an industrial worker for the future industrial land use scenario. This hypothetical industrial worker would be exposed to soil by the direct contact routes, incidental ingestion and dermal contact.

It is also possible that a future construction worker may be exposed to these subsurface soils during excavation activities. However, the duration of exposure for a construction worker would be much shorter than that expected for an industrial worker, as it is limited to only the time period that the excavation activity is occurring. Therefore, only the future industrial worker was evaluated in this assessment, as this would be the most highly exposed potential receptor.

3.1.3 Potentially Complete Exposure Pathways

Complete exposure pathways require exposure media with elevated levels of COIs and receptors with the opportunity to contact these media. The previous sections described the potential exposure pathways at this site under current and future land use conditions as well as the likely receptors. Exposures resulting from all potentially complete pathways are quantitatively evaluated in this assessment. Therefore, the evaluation will consider the scenario of subsurface soil exposure to a future industrial worker via incidental ingestion and dermal contact.

3.2 Quantification of Exposure Point Concentrations

Potential exposure to constituents in the environment is directly proportional to the concentrations of constituents in environmental media (e.g., soil) and characteristics of exposure (e.g., frequency and duration). The concentrations at exposure points generally are referred to as exposure point concentrations (EPCs). The analytical results for samples from a given area are combined to derive a single concentration (EPC) for each constituent that represents the level of that constituent to which potential receptors may be exposed. For constituents in soil, EPCs were statistically calculated from sampling data.

U.S. EPA (1989) guidance discusses the usability of data in risk assessments. In accordance with this guidance, for constituents detected in at least one sample, samples that were non-detects for the constituent of interest ("U" qualifier) were incorporated into statistical calculations at one-half the sample detection limit. This value is assigned to non-detects when averaging because the actual value can range between zero and just below the limit of detection.

For this assessment, the EPCs for constituents in soil are based on the arithmetic mean concentration. These values were presented previously in Table 2-2.

3.3 Estimation of Constituent Exposure and Intake

The U.S. EPA's *Guidelines for Exposure Assessment* (U.S. EPA, 1992a) define constituent exposure as "the condition of a chemical contacting the outer boundary of a human." The constituents are contained in an environmental medium such as water, soil, or air. Generally, two steps are required for a constituent to enter a body: contact with the outer boundary of the body (exposure), and then crossing the boundary from outside to inside the body (intake). For most exposure routes, intake is evaluated in terms of how much of the carrier medium containing the constituents crosses the outer boundary (e.g., amount of soil ingested, volume of air inhaled). Dermal contact pathways, however, are evaluated in terms of uptake, or the absorption of the constituent through the skin.

Two types of doses, applied and internal, are defined for evaluating constituent exposure (U.S. EPA, 1992a). The applied dose is the amount of a constituent present at an absorption barrier (e.g., lung, skin, gastrointestinal tract) and available for absorption. The applied dose is estimated as the amount of constituent ingested, inhaled, or contained in material contacting the skin. This is analogous to the administered dose in a dose-response experiment. The internal dose is the amount of constituent actually absorbed across the barrier and available for internal biological interactions. It is the portion of the internal dose that actually reaches cells, sites, or membranes where adverse effects occur. Doses are generally presented as dose rates (dose per unit time) on a per-unit-body-weight basis (units of mg/kg-day).

Noncarcinogenic health effects are evaluated by calculating the average dose of a constituent over the course of the exposure period. This dose is termed the Average Daily Dose (ADD). Carcinogenic health effects are evaluated in terms of an individual's theoretical increased risk of developing cancer over a lifetime. Although the duration of exposure to a constituent release generally does not last for an entire lifetime, constituent intake for carcinogens is estimated as the average dose over a human lifetime (70 years). This lifetime dose applies specifically to the evaluation of carcinogenic effects and is termed the Lifetime Average Daily Dose (LADD). In a risk assessment, the calculated ADD or LADD are estimated quantitatively using assumptions about the duration, frequency, and magnitude of exposure experienced by each potential receptor, and assumptions about the constituent properties that influence absorption. Table 3-1 presents the general form of the equation used to evaluate intake of constituents.

3.4 Estimation of Constituent Absorption

The administered dose in a dermal exposure pathway is the amount of constituent in the volume of soil contacting the skin. Only a small fraction of this amount of the constituent will actually penetrate the skin and enter the body of a receptor. Dermal exposure calculations are, therefore, always calculated as an absorbed dose and require the inclusion of a dermal absorption factor (DAF). For each of the COIs in soil, dermal absorption factors have been incorporated into the dose calculations. The following list presents the DAFs for each of these constituents (U.S. EPA Region III, 1995).

Constituent	Dermal Absorption Factor (DAF)
Arsenic	0.032
Total Chromium	0.01
Hexavalent Chromium	0.01

3.5 Basis for Exposure Assumptions

The quantitative estimation of constituent intake involves the incorporation of numerical assumptions for a variety of exposure parameters. Exposure assumptions used in these dose calculations are based on U.S. EPA (1989, 1991b, 1997) recommended values. All exposure assumptions utilized in this risk assessment are described below.

3.5.1 All Pathways

The following factors are consistent across both of the exposure pathways considered in this assessment (incidental ingestion and dermal contact).

- ***Exposure Frequency and Duration:*** Exposure frequency for the industrial worker is 5 days a week for 50 weeks a year, or 250 days a year (U.S. EPA, 1991b). The industrial worker is assumed to work for 25 years at the same location, which is the 95th percentile value according to the Bureau of Labor Statistics (U.S. EPA, 1989). Therefore, the exposure duration is equal to 25 years.
- ***Body Weight:*** The default value for average body weight of an adult is 71.8 kg based on U.S. EPA guidance (1997). This value was used for the body weight of the industrial worker in this assessment.
- ***Averaging Time:*** As described above, the doses for noncarcinogenic health effects are averaged over the specific period of exposure for a given receptor. Noncarcinogenic averaging times are, therefore, calculated by multiplying the exposure duration for the receptor by 365 days/year. The resulting noncarcinogenic averaging time for the industrial worker is 9,125 days. Carcinogenic health effects are calculated over a lifetime exposure, so the U.S. EPA (1989) value for average lifetime, 70 years, was used for exposure duration. The resulting carcinogenic averaging time is 25,550 days.

3.5.2 Incidental Ingestion of Soil

The following factors are incorporated into calculations of the soil ingestion pathway. Exposure factors for the industrial worker and the general calculation for this pathway are presented in Table 3-2.

- ***Soil Ingestion Rate:*** The U.S. EPA (1991b) recommended value of 50 mg.day was used to describe soil ingestion for a worker not involved in construction or intrusive activities.

3.5.3 Dermal Contact with Soil

The following factors are incorporated into calculations of the dermal contact with soil pathway. Exposure factors for the industrial worker and the general calculation for this pathway are presented in Table 3-3.

- ***Skin Surface Area:*** Potentially exposed workers are assumed to wear appropriate clothing during outdoor activities that may involve soil contact. Skin surface area available for dermal contact with soil is assumed to be the typical case clothing scenario for outdoor activities as described by U.S. EPA guidance (1997). Exposed skin areas are the head and hands, for a total of 2,000 cm^2.
- ***Soil Adherence Factor:*** The soil adherence factor describes the amount of soil that is assumed to be in contact with the exposed skin surface area. The value 0.6 mg/cm^2 was used in this assessment for all receptors. This is an average of the range 0.2 to 1.0 mg/cm^2 from U.S. EPA (1992b).

- ***Dermal Absorption Factor:*** As described in Section 3.4, a dermal absorption factor is included in calculations of exposure to constituents in soil through dermal contact.

3.6 Summary

The calculations of estimated doses (ADD and LADD) for the complete exposure pathways identified in this section are presented in Table 3-4. These dose estimates will be combined in the risk characterization (Section 5) with the toxicity values presented in the Dose-Response Assessment (Section 4) to estimate potential carcinogenic risks and noncarcinogenic effects.

4.0 DOSE-RESPONSE ASSESSMENT

The dose-response assessment provides a description of the relationship between a dose of a constituent and the anticipated incidence of an adverse health effect (Preuss and Ehrlich, 1987). The majority of existing knowledge about the dose-response relationship is based on data collected from studies of animals (usually rodents), studies of human occupational exposures, and theories about how humans respond to environmental doses of constituents.

The U.S. EPA has developed dose-response assessment techniques to set "acceptable" levels of human exposure to constituents in the environment. These U.S. EPA-derived risk criteria address potential carcinogenic health risks and both subchronic and chronic noncarcinogenic health effects.

4.1 Evaluation of Carcinogenic Responses

The subsections below discuss the assumed mechanisms of carcinogenic response, the derivation of carcinogenic health effects criteria, the manner in which these criteria are used in this risk assessment, and some of the limitations of these values. The limitations are addressed in greater detail in the uncertainty section of this report (Section 6).

4.1.1 Background

U.S. EPA typically has required that potentially carcinogenic constituents be treated as if minimum threshold doses do not exist (U.S. EPA, 1986). The regulatory dose-response curve used for carcinogens only allows for zero risk at zero dose. Thus, for all environmental doses, some level of risk is assumed to be present. Much of the known information on the carcinogenic potential of constituents is derived from animal studies; however, doses administered in these experiments are generally several orders of magnitude greater than levels that could be received through environmental exposure.

To estimate the theoretical response at environmental doses, various mathematical dose-response models are used. U.S. EPA uses the linearized multistage model for low dose extrapolation. This model assumes that the effect of the carcinogenic agent on tumor formation seen at high doses in animal data is basically the same at low doses (i.e., the slope of the dose-response curve can be extrapolated downward to the origin in a linear manner). U.S. EPA's Guidelines for Carcinogen Risk Assessment recommend that the linearized multistage model be employed in the absence of adequate information to the contrary, and that in general models that incorporate low-dose linearity are preferred (U.S. EPA, 1986).

4.1.2 Carcinogenic Health Effects Criteria

U.S. EPA uses a two-step approach for evaluating potential carcinogenic effects of constituents. First, the substance is assigned a weight-of-evidence classification reflecting the likelihood that the constituent is a human carcinogen. Second, a cancer slope factor (CSF) is calculated for known or probable human carcinogens.

In addition to deriving a quantitative estimate of cancer potency, U.S. EPA also assigns weight-of-evidence classifications to potential carcinogens. Constituents are classified as either Group A, Group B1, Group B2, Group C, Group D, or Group E, which are defined according to the U.S. EPA as follows:

- Group A constituents (known human carcinogens) are agents for which there is sufficient evidence to support a causal association between exposure to the agents in humans and cancer.
- Group B1 constituents (probable human carcinogens) are agents for which there is limited evidence of carcinogenicity in humans.
- Group B2 constituents (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or no evidence in humans.
- Group C constituents (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or no human data.
- Group D constituents (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.
- Group E constituents (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

In general, quantitative cancer risk characterization is performed for all Group A, B1, and B2 carcinogens identified at a site.

CSFs are typically calculated for potential carcinogens in classes A, B1, and B2. The slope factor is used to estimate an upperbound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. To derive the CSF, data from animal studies (or occasionally from human epidemiology) are fit to the linearized multistage model, and the upper 95th percent confidence limit on the slope of the resulting dose-response curve is calculated. This slope factor therefore reflects an upperbound estimate of the probability of carcinogenic response per unit dose of a constituent. The CSF is expressed in units of reciprocal dose $(\text{mg/kg-day})^{-1}$.

CSFs that are available for the carcinogens of potential concern are listed in Table 4-1 for oral exposures. As CSFs are not derived for the dermal route of exposure, the oral CSFs will be used to evaluate the dermal pathway. U.S. EPA's Integrated Risk Information System (IRIS; U.S. EPA, 1999) was the primary source for the CSF values. Brief summaries of the derivation of these criteria are presented in Section 4.3.

4.1.3 Estimating the Theoretical Excess Lifetime Cancer Risk

For carcinogenic constituents, a risk assessment evaluates the degree to which a receptor may have a theoretical increased likelihood of developing cancer over a lifetime due to exposure to site-associated constituents. At environmental dosage levels, the CSF is assumed to be constant and potential carcinogenic risk to be directly related to intake. In order to estimate the theoretical excess lifetime cancer risk, the lifetime average daily dose (LADD) of a constituent is multiplied by the CSF as shown:

$$\text{LADD} \times \text{CSF} = \text{Risk}$$

For each pathway, this calculation is carried out for each applicable constituent, and the risks are summed to obtain the total risk due to that pathway. The total theoretical excess lifetime cancer risk for a particular receptor is then calculated as the sum of the risks from all exposure pathways for that receptor.

4.2 Evaluation of Noncarcinogenic Responses

The sections that follow discuss the mechanisms of noncarcinogenic response, the derivation of acceptable dose levels, the manner in which these levels are used in this risk assessment, and some of the limitations of these values. The limitations are addressed in greater detail in the uncertainty analysis section of this report (Section 6).

4.2.1 Background

It is widely accepted that noncarcinogenic biological effects of chemical substances occur only after a threshold dose is achieved. Pharmacokinetic mechanisms (e.g., absorption, distribution, metabolism, or excretion) exist that will minimize the adverse effect. Therefore, a range of exposures and resulting doses up to the threshold level can be tolerated by a receptor with no adverse effects. The threshold dose for a compound is usually estimated from the no observed adverse effect level (NOAEL) or the lowest observed adverse effect level (LOAEL), as determined from animal studies or human data. The NOAEL is the highest dose at which no adverse effects occur, while the LOAEL is the lowest dose at which adverse effects are discernable.

4.2.2 Noncarcinogenic Health Effects Criteria

U.S. EPA uses the NOAEL or LOAEL estimates of threshold dose to establish reference doses (RfDs) for human exposure. A RfD is an estimate of a daily exposure level (dose) that is unlikely to present an appreciable risk of deleterious effects during a lifetime. U.S. EPA has derived both chronic and subchronic RfDs: subchronic RfDs are appropriate for evaluating exposure periods of less than seven years, while chronic RfDs are intended for evaluating long-term exposure. RfDs are expressed in units of dose (mg/kg-day) and incorporate uncertainty factors to account for limitations in the quality or quantity of available data.

The U.S. EPA-derived chronic RfDs that are available for the constituents of interest are provided in Table 4-1. These criteria were identified from U.S. EPA's IRIS database, and as with the CSFs, the oral RfDs will be used to evaluate the dermal exposure pathway. Brief summaries of the derivation of the RfD values are presented in Section 4.3.

4.2.3 Estimating the Likelihood of Adverse Noncarcinogenic Response

The likelihood of occurrence of adverse noncarcinogenic effects depends on the relationship between the RfD and the estimated average constituent dose received by the receptor. Doses less than the RfD are not likely to be associated with any adverse health effects and are, generally, not of regulatory concern. Doses that exceed the RfD are considered to present the potential for adverse effects.

Noncarcinogenic responses are evaluated numerically using parameters known as the hazard quotient (HQ) and hazard index (HI). The HQ is obtained by dividing the average daily dose (ADD) by the RfD as presented below. The average daily dose is the estimated daily dose of a constituent averaged over the specific duration of exposure, which may not necessarily be an entire lifetime.

$$\mathrm{ADD} \;/\; \mathrm{RfD} = \mathrm{HQ}$$

Each dose calculation with a specific combination of constituent, receptor, and exposure pathway, will have a distinct average daily dose and calculated hazard quotient. Hazard quotients associated with all constituents for a particular pathway are summed to yield the hazard index, as indicated:

$$HQ_i + HQ_{ii} + HQ_{iii} + ... = HI$$

If a receptor is subject to exposure through more than one pathway, the hazard indices for all pathways are summed. A calculated hazard index of less than one indicates that an adverse effect would not be anticipated.

Scientifically, the HI approach is highly conservative and does not reflect actual mechanisms of constituent toxicity. Noncarcinogenic constituents produce toxic effects in specific target organs. If the constituents of interest affect different organs or operate through different mechanisms of action, adverse affects due to different constituents are unlikely to be cumulative. The U.S. EPA (1989) recognizes that this situation may occur, and suggests that if the HI is greater than one as a consequence of summing several hazard values, it is appropriate to segregate the compounds by target organ and by mechanism of action and to derive separate hazard indices for each group. For this report, hazard indices were summed without regard to target organ.

4.3 Summary of Critical Studies for Derivation of Toxicity Criteria

This section presents brief summaries of the critical studies upon which CSFs and RfDs of constituents of interest are based.

- **Arsenic**

  IRIS provides an oral reference dose for arsenic (U.S. EPA, 1999). The noncarcinogenic effects of concern are related to the vascular system. Inorganic arsenic has been classified by the U.S. EPA as a known human carcinogen (Group A). IRIS also provides a cancer slope factor for the oral route of exposure to arsenic.

  - **Chronic Oral Reference Dose**

    The U.S. EPA (1999) presents a chronic oral RfD for arsenic as 0.0003 mg/kg-day. The chronic oral RfD for arsenic was derived from a study by Tseng (1977).

    The Tseng study investigated the relationship between peripheral circulatory disease characterized by gangrene of the extremities and the arsenic concentrations in drinking water along the southeast coast of Taiwan. The study evaluated 40,421 residents in 37 villages. A positive correlation was observed between the presence of Blackfoot disease (a peripheral vasoconstriction disorder), arsenic concentration, and duration of water intake. This study established a NOAEL of 0.001 to 0.017 mg/L for Blackfoot disease (U.S. EPA, 1984). An uncertainty factor of 1 was used, presumably because the NOAEL is based on epidemiologic data that included a very large study population. There was not a clear consensus among agency scientists on the chronic oral RfD based on this and other studies to date since other studies show a significantly lesser effect of arsenic.

- **Oral Cancer Slope Factor**

  IRIS (U.S. EPA, 1999) presents an oral cancer slope factor of 1.5 (mg/kg-day)$^{-1}$ for arsenic. The U.S. EPA's Risk Assessment Forum has concluded that the most appropriate basis for an oral quantitative estimate is the 1977 study by Tseng of about 40,000 Taiwanese who were exposed to arsenic in their drinking water (U.S. EPA, 1997). The author reported a significant excess of skin cancers in this population when compared to 7,500 residents of Taiwan and Matsu who consumed relatively arsenic- and other constituent-free water (Tseng et al., 1968). The exposed population was reported to have significantly elevated standard mortality ratios for cancer of the bladder, lung, liver, kidney, skin and colon. The cancer cases were reported to have a significant association with arsenic exposure that was dose-related. The arsenic levels in well water ranged from less than 0.0001 ppm in shallow wells to 1.82 ppm.

- **Total Chromium**

An oral reference dose for trivalent chromium is available from IRIS (U.S. EPA, 1999). This value will be used to evaluate total chromium. Trivalent chromium is classified by the U.S. EPA as Group D: not classifiable as to human carcinogenicity.

- **Chronic Oral Reference Dose**

  The U.S. EPA (1999) provides a chronic oral RfD for trivalent chromium of 1.5 mg/kg-day. This dose is based on a chronic rat feeding study conducted by Ivankovic and Preussman (1975) in which groups of 60 male and female rats were fed chromic oxide baked in bread for 600 feedings (850 days). The average total amounts of ingested chromic oxide ranged from 360 g/kg in the low dose group to 1,800 g/kg in the high dose group. No adverse effects were observed in any of the treatment groups.

  Ivankovic and Preussman (1975) also treated smaller groups of rats for approximately 65 feedings (90 days). The highest dose group exhibited a reduction in the absolute weight of livers and spleens; otherwise no adverse effects were observed. The dose of this group was equivalent to 1,468 mg/kg-day. An uncertainty factor of 100 was applied to this NOAEL to account for interhuman and interspecies variability, and an additional modifying factor of 10 was applied to reflect database deficiencies.

- **Hexavalent Chromium**

An oral reference dose for hexavalent chromium is available from IRIS (U.S. EPA, 1999). Hexavalent chromium is classified by the U.S. EPA as Group D (not classifiable as to human carcinogenicity) when exposed via the oral route.

Chronic Oral Reference Dose

The U.S. EPA (1999) provides a chronic oral RfD for hexavalent chromium of 0.003 mg/kg-day. This dose is based on a study by MacKenzie et al. (1958) in which Sprague-Dawley rats were supplied with drinking water containing varying levels of hexavalent chromium (as K_2CrO_4 or chromic chloride). No significant adverse effects were noted in weight gain, food consumption, or appearance, and no pathologic changes were noted in the blood or tissues in any treatment group. The group of rats receiving 25 mg/L of chromium (as K_2CrO_4) did show a reduction in the amount of water consumption. Thus, this level was adjusted to a NOAEL of 2.5 mg/kg-day. An uncertainty factor of 300 was applied to account for interhuman and interspecies variability, and to account for the less-than-lifetime exposure duration of the study. An additional modifying factor of 3 was applied to address concerns regarding gastrointestinal effects in humans (Zhang and Li, 1987).

5.0 RISK CHARACTERIZATION

Risk characterization is the final step of the human health risk assessment process. It includes a description of the nature and magnitude of the potential for occurrence of adverse health effects under a specific set of conditions. In this step, the toxicity assessment and site-specific exposure assessment are integrated into quantitative and qualitative estimates of potential health risks. Potential carcinogenic and noncarcinogenic health risks are calculated and summarized individually for each receptor, medium, and constituent of interest identified in Section 3.1.3. Estimated risks are combined across exposure pathways as appropriate. The following subsections describe the approaches and results for the evaluation of potential carcinogenic and noncarcinogenic effects.

5.1 Carcinogenic Effects

Theoretical excess lifetime cancer risks associated with exposure to potential carcinogenic COIs at the site were estimated by comparing estimated intakes with the constituent-specific CSFs, as described in Section 4.1.3. Theoretical risks are calculated for the industrial worker by combining pathway-specific risks. Table 5-1 presents a summary of the theoretical excess lifetime cancer risks for the industrial worker.

These results may be compared with U.S. EPA criteria for acceptable risks. Various demarcations of acceptable risk have been established by regulatory agencies. U.S. EPA has recommended that sites posing a cumulative theoretical excess lifetime cancer risk of less than 1 x 10^{-4} may not pose an unacceptable risk and may not be candidates for remedial activities (U.S. EPA, 1991a). Under most situations, theoretical excess lifetime cancer risks in the range of 1 x 10^{-4} to 1 x 10^{-6} are considered to be acceptable.

As indicated in Table 5-1, the estimated theoretical excess lifetime cancer risks associated with exposure to COIs at the site are within the range of acceptable risks (1 x 10^{-4} to 1 x 10^{-6}), indicating that significant theoretical excess lifetime cancer risks to the future industrial worker will not occur.

5.2 Noncarcinogenic Effects

Potential noncarcinogenic effects associated with exposure to COIs at the site were estimated by comparing estimated intakes with the constituent-specific RfD, as described in Section 4.2.3. The hazard indices (HIs) are then calculated for the industrial worker by combining pathway-specific HIs. Table 5-2 presents the summed hazard indices for the industrial worker.

Noncarcinogenic HIs less than or equal to one are considered acceptable by U.S. EPA (1989). As indicated in Table 5-2, the HI for exposure to COIs at the site is less than one, indicating that adverse noncarcinogenic health effects are not likely to occur.

6.0 UNCERTAINTY ANALYSIS

Uncertainties are inherent in every aspect of a quantitative risk assessment. The inclusion of site-specific factors, which this assessment has attempted to incorporate, decreases uncertainty, although some uncertainty persists in even the most site-specific and accurate risk assessments. A careful and comprehensive analysis of the critical areas of uncertainty in a risk assessment is a very important part of the risk assessment process. The uncertainty analysis provides a context for better understanding the assessment conclusions by identifying the uncertainties that have most significantly affected the assessment results.

U.S. EPA (1992a) guidance stresses the importance of providing a complete analysis of uncertainties so that risk management decisions take these uncertainties into account when evaluating risk assessment conclusions. The major sources of uncertainty in this risk assessment are identified qualitatively below.

6.1 Uncertainties in Hazard Identification

Uncertainties in the hazard identification step of the risk assessment are associated with the available analytical data. The environmental sampling used in this assessment was designed to locate the highest likely concentrations of constituents. Random sampling would have been more likely to provide a representative set of values to be incorporated into the risk assessment for consistency with other exposure considerations. This directed sampling effort tends to lead to an overestimation of exposure point concentrations.

6.2 Uncertainties in Exposure Assessment

The U.S. EPA approach to exposure assessments generally requires standard exposure scenarios rather than realistic site-specific evaluations of exposure. Under this approach, if a constituent is found to be present at a site, it is assumed that exposure to that substance will occur, regardless of whether that exposure is realistic or likely. Elements of uncertainty in exposure assessment include the following.

- ***Use of Default Exposure Factors:*** The scientific literature contains many examples of carefully designed and conducted studies which indicate that appropriate environmental exposure factors are significantly lower than those recommended by the U.S. EPA (1989, 1991b). These include soil ingestion rates (Calabrese et. al., 1989) in particular. Since this risk assessment is designed to provide a relative index for comparison of the risks associated with different remedial alternatives, the U.S. EPA default values were used herein. The use of the U.S. EPA default values tends to result in overestimates of the risks.
- ***Chemical Absorption Factors:*** When evaluating the risks associated with constituents in soil, typically the U.S. EPA does not incorporate a factor to address gastrointestinal absorption. However, it should be noted that many examples of gastrointestinal absorption less than 100% exist in the scientific literature. Using a gastrointestinal absorption factor of 100% for the three inorganic COIs in this risk assessment results in an overestimation of the risks due to soil ingestion.

6.3 Uncertainties in Toxicity Assessment

Toxicity assessments almost never incorporate direct data about the effects of environmental constituents on human receptors. Very little useful epidemiological data are available for most constituents for human populations near waste sites. The epidemiological studies on exposures in the workplace are largely inapplicable to evaluation of hazardous waste site because the exposure concentrations, frequencies, and durations are very different. In all, there is almost no direct data on the toxicity of chemicals to residential, recreational, or industrial receptors subject to environmental exposure levels. Therefore, toxicity assessments for nearly all constituents involve the extrapolation of results from studies on animals. The following are standard assumptions applied by the U.S. EPA when extrapolating the results of studies of carcinogenicity in animals to humans (HWCP, 1993).

- Any constituent showing carcinogenic activity in any animal species will also be a human carcinogen.
- There is no threshold dose for carcinogens.
- The results of the most sensitive animal study are appropriate to apply to humans.
- Humans are more sensitive than the most sensitive animal species on a body weight basis.

These considerations are generally inappropriate when applied to multiple chemicals in a specific situation. Other elements of uncertainty in toxicity assessment include the following.

- ***Dose Response Assessment - Potential Carcinogens:*** Uncertainties are introduced in animal to human extrapolation and high to low dose extrapolation. Mathematical models are used to estimate the possible responses due to exposure to chemicals at levels far below those tested in animals. These models contain several limitations which should be considered when the results (e.g., risk estimates) are evaluated. Primary among these limitations is the uncertainty in extrapolation of results obtained in animal research to humans and the shortcomings in extrapolating responses obtained from high-dose research studies to estimate responses at very low doses. For example, humans are typically exposed to environmental chemicals at levels that are less than a thousandth of the lowest dose tested in animals. Such doses may be easily degraded or eliminated by physiological internal mechanisms that are present in humans (Ames, 1987; Abelson, 1990). Thus, a limited ability exists to use the results of standard rodent bioassays to understand the human biological hazard or cancer risks posed by routine levels of exposure (Crump et al., 1976; Sielken, 1985).
- ***Upper Bound Cancer Slope Factors:*** The U.S. EPA cancer slope factors are considered to be plausible upper bounds of risk at a 95 percent confidence level. Thus there is a 95 percent probability that the true risks do not exceed these levels, and the risks are likely to be much lower. The Carcinogen Assessment Group (U.S. EPA, 1986) states that the use of the linearized multistage model and upper bound risk estimates is appropriate, but that the lower limit of risk may be as low as zero. When biological factors are considered, the best estimate of the risk at very low levels is often zero (U.S. OMB, 1990).
- ***Dose Response Assessment – Noncarcinogens:*** Approaches typically utilized for designating reference doses are highly conservative. The U.S. EPA (1989) applies a factor of 10 to a No Observed Adverse Effect Level (NOAEL) for a chemical in an animal study for animal-to-human extrapolation. An additional factor of 10 is applied for interindividual variation in the human population, and additional factors of 10 may be applied to account for limitations in data quality or incomplete studies. Frequently,

reference doses are derived from animal studies which have little quantitative bearing on potential adverse effects in humans. Some of this uncertainty may be reduced if the absorption, distribution, metabolic fate, and excretion parameters of a chemical are known.

Because the fate and mechanism of action of a chemical may differ in animals and humans, effects observed in animals may not be observed in humans, resulting in an overestimation of potential adverse health effects. This is unlikely to occur in the converse, since the majority of chemicals have been studied in multiple animal species. Interspecies dose conversion may also be limited by differences in lifespan, body size, breathing rates, or the route of administration utilized in a study.

6.4 Uncertainties in Risk Characterization

The lack of actual current human exposure to contamination at many hazardous waste sites results in a situation where the public incorrectly perceives hazardous waste sites as a major health risk, while in reality these sites present moderate to low risks compared to many other environmental and public health problems (HWCP, 1993). U.S. EPA has concluded that human health risks from waste sites are ranked below risks from indoor radon, pesticides on food, other indoor air pollutants, exposure to chemicals in the workplace, air pollution, consumer exposure and depletion of stratospheric ozone (U.S. EPA, 1987).

- ***Risk Characterization:*** The typical approach to risk assessment involves conservatively multiplying the upper bound exposure assumptions together to evaluate exposure. U.S. EPA risk assessment guidance (1989) specifies that numerous factors in the exposure equation should each be represented by the 95th percentile value for that variable. These factors include the representative concentration, the contact rate with the environmental medium, and the exposure frequency and duration. Multiplying all of these upper bound values results in a risk estimate which is higher than the risks to 99.99% of the population. Thus, virtually all potentially exposed receptors will have a much lower level of risk than calculated following U.S. EPA guidance.
- ***Assumed Additivity:*** Scientifically, the additive approach for noncarcinogenic effects is highly conservative and does not reflect actual mechanisms of constituent toxicity when individual constituents have the potential to affect different target organs. If the COIs affect different organs or operate through different mechanisms of action, adverse effects due to different constituents are unlikely to be cumulative. Assuming additivity, as was done in this assessment, would overestimate hazard quotients.

All of the steps of the exposure assessment and toxicity assessment, including all of the factors incorporated into the dose calculations, individually include a conservative "safety margin." When all of these factors are combined, the margins of error are compounded and scientific accuracy is sacrificed.

7.0 CONCLUSIONS

This human health risk assessment evaluated hypothetical exposure of a future industrial worker to subsurface soils. Constituents of interest consist of arsenic, total chromium, and hexavalent chromium. The industrial worker was evaluated for exposure to these constituents via incidental ingestion of soil and dermal contact with soil.

The results of the assessment indicate that theoretical excess lifetime cancer risks and hazard indices for the industrial worker are within acceptable limits according to the U.S. EPA (1989, 1991a). The theoretical excess lifetime cancer risk for this receptor was 8.5×10^{-5}, which is within the acceptable range of 10^{-6} to 10^{-4}. The summed hazard index was 0.53, which is below U.S. EPA's target benchmark of 1.0. Therefore, adverse health effects will not occur to industrial workers at the site under the hypothetical case in which the investigated fill materials (currently beneath pavement and/or in the subsurface at the facility) would be exposed as surface soil.

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TABLE 2-1
SOIL DATA USED IN THE RISK ASSESSMENT
Athens, NY

Sample Number	Depth (ft)	Arsenic (mg/kg)	Chromium (total) (mg/kg)	Chromium VI (mg/kg)
C-1	14.5 - 15.5	5.4	22.3	2.5 U
C-2	4.5 - 5.0	192	229	17.6
C-3	4.25 - 4.5	662	580	21.6
C-4	6.25 - 6.5	246	155	10
C-5	4.5 - 5.5	7.5	39.9	2.4 U
C-6	13.5 - 14.0	16	41.9	2.4 U
C-7	6.5 - 7.0	70.9	46.5	2.2 U
C-8	6.0 - 6.5	25.2	99	3.5
C-9	7.0 - 7.5	50.9	29.8	2.1 U
C-10	7.0 - 7.5	404	312	42
C-11	2.5 - 3.0	74.1	21.4	2.1 U
C-12	2.0 - 2.5	9.2	730	2.1 U
C-13	1.5 - 2.0	71.7	84.7	3.8
C-14	1.5 - 2.0	911	120	30.5
C-15	2.5 - 3.0	75	28.3	3.4

U - Constituent not detected; value shown is the detection limit.

TABLE 2-2
SUMMARY OF ANALYTICAL SOIL DATA
Athens, NY

Constituent	Frequency of Detection	Range of Detected Values (mg/kg)	Range of Detection Limits (mg/kg)	Arithmetic Mean Concentration [1] (mg/kg)	Sample Number of Maximum Detection
Arsenic	15 / 15	5.4 - 911	--	188	C-14
Chromium (total)	15 / 15	21.4 - 730	--	169	C-12
Chromium VI	8 / 15	3.4 - 42	2.1 - 2.5	9.35	C-10

[1] The arithmetic mean incorporates non-detect results at one-half the detection limit.

TABLE 3-1
GENERAL FORMULA FOR CALCULATION OF CONSTITUENT INTAKES
Athens, NY

Symbol	Factor	Units	Comments
C	Constituent Concentration	mg/kg, mg/L, mg/m^3	Concentration of constituent in environmental medium.
CR	Contact Rate	mg/day, L/day	Receptor's rate of contact with environmental medium.
EF	Exposure Frequency	days/year	Days per year that receptor may be exposed.
ED	Exposure Duration	years	Number of years during which receptor may be exposed.
BW	Body Weight	kilograms	Intake is normalized for receptor's body weight.
AT	Averaging Time	days	Period over which exposure is averaged.

Equation:

$$\text{Intake (mg/kg-day)} = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

TABLE 3-2
FACTORS USED IN DOSE CALCULATIONS: INCIDENTAL INGESTION OF SOIL
Athens, NY

Symbol	Factor	Industrial Worker Value	Source
CS	Constituent Concentration in Soil (mg/kg)	constituent-specific	Table 2-2
IR	Soil Ingestion Rate	50 mg/day	USEPA, 1991b
ABS	Gastrointestinal Absorption Factor	100%	conservative
CF	Conversion Factor	1 x 10^{-6} kg/mg	--
EF	Exposure Frequency	250 days/yr	USEPA, 1991b
ED	Exposure Duration	25 years	USEPA, 1989
BW	Body Weight	71.8 kg	USEPA, 1997
AT	Averaging Time	9,125 days (NC) 25,550 days (C)	USEPA, 1989

$$\text{Total Dose (adjusted for relative absorption)} = \frac{CS \times IR \times ABS \times CF \times EF \times ED}{BW \times AT}$$

NC - Noncarcinogenic averaging time
C - Carcinogenic averaging time

TABLE 3-3
FACTORS USED IN DOSE CALCULATIONS: DERMAL CONTACT WITH SOIL
Athens, NY

Symbol	Factor	Industrial Worker Value	Source
CS	Constituent Concentration in Soil (mg/kg)	constituent-specific	Table 2-2
CF	Conversion Factor	1×10^{-6} kg/mg	--
SA	Skin Surface Area	2,000 cm^2	USEPA, 1997
AF	Soil Adherence Factor	0.6 mg/cm^2	USEPA, 1992b
DAF	Dermal Absorption Factor (unitless)	constituent-specific	Section 3.4
EF	Exposure Frequency	250 days/yr	USEPA, 1991b
ED	Exposure Duration	25 years	USEPA, 1989
BW	Body Weight	71.8 kg	USEPA, 1997
AT	Averaging Time	9,125 days (NC) 25,550 days (C)	USEPA, 1989

$$\text{Total Dose (adjusted for relative absorption)} = \frac{CS \times CF \times SA \times AF \times DAF \times EF \times ED}{BW \times AT}$$

NC - Noncarcinogenic averaging time
C - Carcinogenic averaging time

TABLE 3-4
ESTIMATED DOSES FOR THE INDUSTRIAL WORKER
Athens, NY

Exposure Pathway	Constituent	Average Daily Dose (ADD) (mg/kg-day)	Lifetime Average Daily Dose (LADD) (mg/kg-day)
Incidental Ingestion of Soil	Arsenic	8.97E-05	3.20E-05
	Chromium (total)	8.06E-05	2.88E-05
	Chromium (hexavalent)	4.46E-06	1.59E-06
Dermal Contact with Soil	Arsenic	6.89E-05	2.46E-05
	Chromium (total)	1.93E-05	6.91E-06
	Chromium (hexavalent)	1.07E-06	3.82E-07

TABLE 4-1
HEALTH EFFECTS CRITERIA FOR CONSTITUENTS OF INTEREST
Athens, NY

Constituent	USEPA Weight-of-Evidence Classification	Oral Cancer Slope Factor (CSFo) (mg/kg day)$^{-1}$	Chronic Oral Reference Dose (RfDo) (mg/kg-day)
Arsenic	A	1.5	0.0003
Chromium (total)	D	NA	1.5
Chromium (hexavalent)	D *	NA	0.003

Source of values: IRIS (USEPA, 1999)

NA - Not available.

* It should be noted that hexavalent chromium is classified as Group D by the oral route of exposure, but is Group A by the inhalation route (USEPA, 1999).

TABLE 5-1
SUMMARY OF THEORETICAL EXCESS LIFETIME CANCER RISKS FOR THE INDUSTRIAL WORKER
Athens, NY

Exposure Pathway	Constituent	Lifetime Average Daily Dose (LADD) (mg/kg-day)	Slope Factor $(mg/kg/day)^{-1}$	Potential Cancer Risk
Incidental Ingestion of Soil	Arsenic	3.20E-05	1.5	4.8E-05
	Chromium (total)	2.88E-05	NA	NA
	Chromium (hexavalent)	1.59E-06	NA	NA
	Pathway Total			4.8E-05
Dermal Contact with Soil	Arsenic	2.46E-05	1.5	3.7E-05
	Chromium (total)	6.91E-06	NA	NA
	Chromium (hexavalent)	3.82E-07	NA	NA
	Pathway Total			3.7E-05
TOTAL THEORETICAL EXCESS LIFETIME CANCER RISK				**8.5E-05**

NA - Chromium is not carcinogenic via the oral route of exposure.

TABLE 5-2
SUMMARY OF HAZARD INDICES FOR THE INDUSTRIAL WORKER
Athens, NY

Exposure Pathway	Constituent	Average Daily Dose (ADD) (mg/kg-day)	Reference Dose (mg/kg-day)	Hazard Index
Incidental Ingestion of Soil	Arsenic	8.97E-05	0.0003	0.299
	Chromium (total)	8.06E-05	1.5	0.000054
	Chromium (hexavalent)	4.46E-06	0.003	0.0015
	Pathway Total			0.3004
Dermal Contact with Soil	Arsenic	6.89E-05	0.0003	0.230
	Chromium (total)	1.93E-05	1.5	0.000013
	Chromium (hexavalent)	1.07E-06	0.003	0.00036
	Pathway Total			0.230
TOTAL HAZARD INDEX				**0.53**