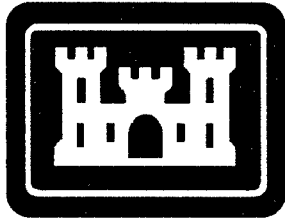


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US Army Corps of Engineers

Toxic and Hazardous
Materials Agency

COOSA RIVER STORAGE ANNEX
TALLADEGA, ALABAMA
FFIS No. : AL-213820231

ENVIRONMENTAL INVESTIGATION REPORT
VOLUME 1 OF 2
SEPTEMBER 1992

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ABBREVIATIONS

ACM	Asbestos containing materials
AAAP	Alabama Army Ammunition Plant
ADEM	Alabama Department of Environmental Management
ALPHAG	IRDMIS abbreviation for radon
ANAD	Anniston Army Depot
ANG	Alabama National Guard
Annex	Coosa River Storage Annex
ATSDR	Agency for Toxic Substances and Disease Registry, U.S. Centers for Disease Control
B	IRDMIS data qualification flagging code, see Table 4-1
BETX	Benzene, ethylbenzene, toluene, and xylenes
bls	Below land surface
BRA	Baseline risk assessment
C	Percent complete
°C	degrees Centigrade
C6H6	IRDMIS abbreviation for the analyte benzene
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cm	Centimeter(s)
CROP	Coosa River Ordnance Plant
D	IRDMIS data qualification flagging code, see Table 4-1
DOI	U.S. Department of Interior
13DMB	IRDMIS abbreviation for the analyte 1,3-dimethylbenzene (a.k.a., p-xylene)
DNB	Dinitrobenzene
1,3-DNB	1,3-Dinitrobenzene; abbreviated in IRDMIS as 13DNB
DNT	Dinitrotoluene
2,3-DNT	2,3-Dinitrotoluene
2,4-DNT	2,4-Dinitrotoluene; abbreviated in IRDMIS as 24DNT
2,5-DNT	2,5-Dinitrotoluene
2,6-DNT	2,6-Dinitrotoluene; abbreviated in IRDMIS as 26DNT
3,4-DNT	3,4-Dinitrotoluene

ABBREVIATIONS (cont.)

t-DNT	Technical grade DNT
DQOs	Data quality objectives
ECAO	Environmental Criteria Assessment Office, U.S. EPA
EI	Environmental Investigation
EPIC	Environmental Photographic Interpretation Center, U.S. EPA
ETC6H5	IRDMIS abbreviation for the analyte ethylbenzene
°F	degrees Fahrenheit
FFA	Federal facilities agreement
FR	Federal Register
FS	Feasibility Study
ft	Foot or feet, as appropriate
ft ²	Square feet
F&W	Fish and wildlife; ADEM surface water quality usage designation
FWS	Fish and Wildlife Service
g	Gram(s)
G	IRDMIS data qualification flagging code, see Table 4-1
GI tract	Gastrointestinal tract
Hg	Mercury; abbreviated in IRDMIS as HG
HI	Hazard Index
HMX	High Melting Explosive, cyclotetramethylene tetranitramine
IR	Infrared Spectroscopy
IRIS	Integrated Risk Information System, U.S. EPA
LOAEL	Lowest-Observed-Adverse Effect Level
LP	Liquefied propane
m	Meter(s)
MCL	Maximum Contaminant Level
MEC6H5	IRDMIS abbreviation for the analyte toluene (a.k.a., methylbenzene)
mg	Milligram
mg/kg	Milligrams/kilogram
mg/kg-day	Milligrams/kilogram-day
mg/L	Milligrams/Liter
msl	Mean sea level

ABBREVIATIONS (cont.)

MTBE	Methyl tertiary butyl ether
NB	Nitrobenzene
NC	Nitrocellulose
NCP	National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300
nm	Nanometer(s)
NOAA	National Oceanic and Atmospheric Administration, U.S. Department of Commerce
NOAEL	No-Observed-Adverse Effect Level
NPL	National Priorities List
PA	Preliminary Assessment
Pb	Lead; abbreviated in IRDMIS as PB
PCBs	Polychlorinated biphenyls
PCB016	IRDMIS abbreviation for the analyte PCB-1016
PCB221	IRDMIS abbreviation for the analyte PCB-1221
PCB232	IRDMIS abbreviation for the analyte PCB-1232
PCB242	IRDMIS abbreviation for the analyte PCB-1242
PCB248	IRDMIS abbreviation for the analyte PCB-1248
PCB254	IRDMIS abbreviation for the analyte PCB-1254
PCB260	IRDMIS abbreviation for the analyte PCB-1260
pCi/L	picoCuries/Liter
PMCL	Proposed MCL
ppb	Parts per billion
ppm	Parts per million
PRGs	Preliminary Remediation Goals
Q _{avg}	Measured average flow
7-day Q ₂	Median annual 7-day low flow with recurrence interval of 2 years
7-day Q ₁₀	Median annual 7-day low flow with recurrence interval of 10 years
QCP	Quality Control Plan
R	IRDMIS data qualification flagging code, see Table 4-1
%R	Percent recovery
RAGS	Risk Assessment Guidance for Superfund, U.S. EPA
RBC	Red blood cell

ABBREVIATIONS (cont.)

RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive, cyclotrimethylene trinitramine
RfD	Reference dose
RME	Reasonable Maximum Exposure
RPD	Relative percent difference
S	Swimming; ADEM surface water quality usage designation
SDEF Guidance	Standard Default Exposure Factors Guidance, U.S. EPA
TNB	Trinitrobenzene
1,3,5-TNB	1,3,5-Trinitrobenzene; abbreviated in IRDMIS as 135TNB
TNT	Trinitrotoluene
2,4,6-TNT	2,4,6-Trinitrotoluene; abbreviated in IRDMIS as 246TNT
TPHC	Total petroleum hydrocarbons; synonymous in this report with TRPH.
TRPH	Total recoverable petroleum hydrocarbons; synonymous in this report with TPHC, the abbreviation used by IRDMIS for this analyte.
U/BK Model	Uptake/Biokinetic Model (Version 5.0), U.S. EPA
ug/g	Micrograms/gram, synonymous with mg/kg and ppm in soils, sludges and sediments
ug/kg	Micrograms/kilogram, synonymous with ppb in soils, sludges and sediments
ug/dL	Micrograms/decaLiter
ug/L	Micrograms/Liter, synonymous with ppb in aqueous solutions
ug/m ³	Micrograms/cubic meter
USACE	U.S. Army Corps of Engineers
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geologic Survey
UST	Underground storage tank
V	IRDMIS data qualification flagging code, see Table 4-1
XYLEN	IRDMIS abbreviation for the analyte xylenes

**EXECUTIVE SUMMARY
OF THE
ENVIRONMENTAL INVESTIGATION OF THE
COOSA RIVER STORAGE ANNEX
TALLADEGA, ALABAMA
FFIS No.: AL-213820231**

ENVIRONMENTAL MEDIA SAMPLING AND ANALYSIS

Sampling activities conducted during this Environmental Investigation (EI) are summarized below:

- o Collection and analysis of soil, surface water/sediment, wipe, and radon samples from areas previously identified to be potential contamination sources; and
- o Collection and analysis of soil and surface water/sediment samples to define background levels of potential contaminants of concern.

Areas of environmental significance at the Annex that were investigated during the course of this EI include the 136 storage igloos, the 5 loading ramps (3404 through 3408), the lone debris pile, 21 areas of ground disturbance, 4 "excavated" ponds, and 10 stream sampling stations. Two of these stream sampling locations were upstream for comparison to the 6 samples collected on the Annex and the 2 locations downstream of the Annex. A background surface water and sediment sample was collected from a wetland pond in the northeast buffer zone, which is of the same wetland class as the 4 "excavated" ponds, for comparison to the pond samples from on the Annex. Background soil samples were collected from 3 locations within the buffer zone for comparison to soil samples collected on the Annex.

NATURE AND EXTENT OF CONTAMINATION

Site-activity attributable chemicals of potential concern detected on igloo interior surfaces at the Coosa River Storage Annex are the nitroaromatics nitrobenzene, 1,3,5-TNB and 2,4,6-TNT.

Site-activity attributable chemicals of potential concern detected in soils at the Annex are lead and the nitroaromatics 2,4-DNT and 2,6-DNT.

Chemicals of potential concern detected in surface water or sediments at the Annex are lead and nitrocellulose. Although lead was detected in stream surface water and sediment samples,

and in pond sediment samples, it was not at levels above background ranges. Although nitrocellulose was detected in sediments in three out of the four onsite ponds sampled and in surface waters of all four onsite ponds sampled, it was not detected in any of the stream sediment or stream surface water samples. None of the nitroaromatics detected on igloo interior surfaces or soils at the Annex have been detected during this EI in any surface water or sediment samples, neither in streams nor in ponds.

The results of the EI indicate that igloo interior surfaces at a limited number of igloos, and soils at limited locations, show detectable levels of site-activity attributable potential chemicals of concern -- chiefly the nitroaromatics 2,4-DNT (soil only), 2,6-DNT (soil only), 2,4,6-TNT (igloo interior surfaces only), nitrobenzene (igloo interior surfaces only), and 1,3,5-TNB (igloo interior surfaces only). Soils at numerous locations also show detectable levels of lead, mercury and nitrocellulose. The results of the EI indicate that although the chemicals of potential concern have been released to the environment, they are not migrating from the soil media to the other environmental media examined.

Concentrations of naturally-occurring radon in igloo interiors are also of potential concern.

BASELINE RISK ASSESSMENT

APPROACH

A baseline risk assessment was performed to evaluate the potential threat to human health and the environment assuming no remedial action at the Coosa River Storage Annex.

In order to provide an upper range of possible exposures for this risk assessment, it was assumed that, in the future, the Coosa River Storage Annex may be subdivided into 1,000 ft by 1,000 ft square residential plots (exposure units) approximately 23 acres in size (1,000,000 ft²) and that individuals would integrate exposure to contaminants in soil over this area. This size area was chosen because an area this size centered over the most highly contaminated soil would include all of the highest concentrations of the chemicals of potential concern identified in soil at the site.

Under the conditions of a residential exposure scenario, it is assumed that the buildings currently onsite would have been removed and replaced with private dwellings so that no exposures to contaminated air and surfaces in the igloo interiors is anticipated. It should be noted that during the demolition process and subsequent residential construction, contaminated soil, which is located primarily in close proximity to the front of the igloos, would most likely be removed, or redistributed and probably substantially diluted. Residential

exposures based on the soil concentrations currently existing at the site are therefore highly likely to be overestimations.

Potential inhalation intakes are anticipated to be insignificant compared to ingestion and dermal intakes under the conditions of the residential scenario and so were not estimated.

If the igloos remain standing, the most likely potentially exposed population are individuals (private or military) who may visit the site occasionally while engaged in storing and removing material from the storage igloos. Accordingly, potential exposures to soil, interior surfaces, and interior air of igloos have been quantified under such a commercial/industrial use scenario. This commercial/industrial use scenario corresponds to the current site usage.

CONCLUSIONS

The conditions at the Coosa River Storage Annex do not present an adverse environmental or ecological impact.

Exposure of children to lead-contaminated soil under the conditions of exposure of the very conservative residential scenario does not represent an unacceptable health risk. According to the U.S. EPA's Uptake/Biokinetic (U/BK) Model (Version 5.0), the blood lead levels estimated to occur in children as a result of exposure to lead-contaminated soil in a residential setting at the Annex is 5.07 ug/dL. In the absence of exposure to any other lead-contaminated media (e.g., water, air), 2.51% of the children exposed to the highest detected level of lead are expected to have blood lead levels exceeding 10 ug/dL, which is within the U.S. EPA's acceptable range of 5% or less.

Based upon either current or reasonable future land usage, the analysis of baseline risk indicates that no noncarcinogenic hazards to human health exist at the Coosa River Storage Annex (i.e., hazard quotients and indices are less than 1.0), and that elevated (i.e., greater than 1×10^{-6}) carcinogenic risk exists based upon two exposure pathways:

- (1) Inhalation of naturally-occurring radon gas within the igloo interiors.

At an assumed 20 days/year exposure frequency and an exposure duration of 5 or 10 years, most risks due to radon exposure are in the range of 1×10^{-4} ; at an exposure duration of only 1 year, most risks are in the range of 1×10^{-5} and none are greater than 1×10^{-4} .

- (2) Contact with shallow subsurface soils at selected igloos and one loading ramp.

Under the most likely conditions of future site usage -- a commercial/industrial scenario similar to the current usage of the site -- only three igloos (Igloos 1702, 2101 and 2108) are associated with elevated (i.e., greater than 1×10^{-6}) carcinogenic risks due to site-activity attributable chemicals of potential concern; however, the risks are all less than 1×10^{-4} . These carcinogenic risks are within the 1×10^{-6} to 1×10^{-4} target risk range identified by the U.S. EPA [55 FR 8716].

If a potential future residential use of the property is assumed, potential risks due to exposure to site-activity attributable contaminants in soil are limited to Igloos 1702, 1805, 2102, 2108, 2304 and Loading Ramp 3405. Elevated (i.e., greater than 1×10^{-6}) carcinogenic risks exist at these locations. However, the potential carcinogenic risk exceeds 1×10^{-4} only at Igloos 1702, 2101 and 2108. Therefore, under this assumed albeit unlikely future use scenario, Igloos 1702, 2101 and 2108 present unacceptable (greater than 1×10^{-4}) carcinogenic risks due to soil exposure.

Furthermore, residential development of the property would most likely require demolition of the igloos and loading ramps, and removal of the demolition debris would likely result in partial removal of contaminated soils and dilution through soil redistribution during construction activities.

DATA LIMITATIONS

The investigatory approach utilized in this EI targeted only those media and locations most likely to have been impacted during the operational life of the Coosa River Storage Annex. Samples were collected at locations where any contaminants present were likely to be concentrated. No investigation of groundwater, or of soils at depths greater than 6 inches, was conducted during this EI.

Where multiple samples (either multiple investigative samples over subareas, field replicates, or matrix spike samples) were collected from a single site feature, the highest concentration detected was used to estimate the exposure point concentrations utilized during the baseline risk assessment.

Conclusions regarding soil exposure risks are based on single samples taken from discrete areas in front of igloos where any contaminants may be concentrated. Conclusions regarding building interior surface exposure risks are likewise based upon a single composite sample of

surface contaminants within each igloo taken from discrete areas within each igloo where any contaminants may be concentrated. Conclusions regarding risks due to radon inhalation are also based upon a single timed composite sample collected over a period with little ventilation since the igloo was sealed, and hence would not represent conditions under active usage.

PRELIMINARY REMEDIAL ACTION OBJECTIVES

According to the U.S. EPA's OSWER Directive 9355.0-30, Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions, "[w]here the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than $[1 \times] 10^{-4}$, and the non-carcinogenic hazard quotient is less than 1, [remedial] action is generally not warranted unless there are adverse environmental impacts."

Since conditions at the Annex meet these criteria, consistent with the NCP the Annex should be considered to be a no action site. Current U.S. EPA guidance further states that "in such situations, the FS [Feasibility Study] should either be scaled down as appropriate to that site and its potential hazard, or eliminated altogether." Since the Annex is not on the National Priorities List (NPL), and is not under a Federal facilities agreement (FFA) with U.S. EPA, it is appropriate that no FS be performed.

The following subsections are presented with the intention of providing disclosure of these EI findings to potential property buyers/transferees.

It is the responsibility of the current property owner/transferor to disclose to the potential buyer/transferee of the property the results of this EI, and to inform the transferee to assess the need to conduct remedial action consistent with the transferee's intended usage.

Potential preliminary remedial action objectives therefore focus on eliminating or limiting completed exposure pathways, either through institutional controls/administrative safeguards, or through remediating the contamination to levels which no longer present unacceptable risks, or through a combination of these two approaches, consistent with intended future site usage.

In accordance with the Department of the Army Technical Bulletin TB 700-4, Decontamination of Facilities and Equipment, all contaminated items which are to be released to the general public are to be decontaminated to the XXXXX ("five Xs") degree before transfer. "Five Xs indicate the equipment or facilities have been completely decontaminated, and are free of hazard and may be released for general use or to the general public."

All contaminated items which are to be either transferred to a qualified government installation or activity, or furnished to a qualified user within industry, are to be decontaminated to a minimum of XXX ("three Xs") degree before transfer. Three Xs indicate that the equipment or facilities have been "decontaminated by approved procedures and no contamination can be detected ... and are considered safe for their intended use." Items decontaminated to this degree can be furnished to industry or the general public if "administrative and technical safeguards will eliminate risk of injury."

The findings of the Baseline Risk Assessment, as summarized above, indicate that the facilities at the Annex present no unacceptable carcinogenic risks or noncarcinogenic hazards due to site-activity attributable chemicals of concern for commercial/industrial usage.

If future site usage is commercial/industrial, similar to the current usage, the sole preliminary remedial action objective is to:

- (1) Assess the need to limit inhalation exposures to naturally-occurring radon gas in the buildings either through duration limitations or through reduction methods such as increased ventilation.

Carcinogenic risks slightly above the 1×10^{-4} upper bound of the U.S. EPA's target risk range exist at the both the 5- and 10-year exposure durations for inhalation of naturally-occurring radon. At the 1-year exposure duration, however, the carcinogenic risks are within the target risk range.

If the site is used in the future for residential purposes corresponding to the exposure assumptions of the residential use scenario, the sole preliminary remedial action objective is to:

- (2) Limit or eliminate contact with shallow subsurface soils which present potential carcinogenic risks which exceed 1×10^{-4} at Igloos 1702, 2101 and 2108.

PRELIMINARY REMEDIAL ALTERNATIVES

A preliminary remedial alternative has been formulated for each of the two identified media-specific preliminary remedial action objectives. Other viable alternatives are potential institutional controls, such as deed restrictions or administrative safeguards which restrict usage of certain locations and thereby eliminate exposure, or limit exposure duration or exposure frequency, or establish standard operating procedures which do the same. If any

physical remediation is to be undertaken, remedial alternatives should be evaluated in greater detail.

RADON

Radon concentrations within buildings may vary greatly over time. Furthermore, concentrations at different locations in the same building often vary by a factor of two or more. Because of these temporal and spatial variations, U.S. EPA guidance recommends follow-up measurement when the initial screening measurement exceeds 4 pCi/L.

If the initial screening measurement exceeds 4 pCi/L and is less than 20 pCi/L, as is the case with the initial screening measurements conducted during this EI, the recommended follow-up measurement consists of 12-month integrated measurements made in several areas of the building. The 12-month measurement is achieved either through 4 successive 90-day measurements using gross alpha track radon detectors, as were used during the screening measurement conducted during this EI, or through the use of a long-term measurement device, such as a 12-month alpha-track detector. The average annual concentration in the building then can be used to estimate health risks and as a comparison to established guidance levels on the need for remedial action.

Considering that some of the buildings at the Annex are periodically utilized for training exercises during which ventilation is increased due to the door being open, the 12-month alpha detector would best integrate the actual radon gas concentration in the building interiors under real usage conditions. Placement of detectors at multiple locations in the buildings is also recommended during follow-up long term monitoring. Emphasis should be given to conducting the follow-up monitoring in buildings intended to be utilized by user populations under the usage scenario defined by the potential property transferee.

The average annual concentration in the individual buildings then can be used to reevaluate health risks and as a comparison to established guidance levels on the need for remedial action for those buildings intended for use. According to U.S. EPA guidance, no decision on the need for permanent corrective action for radon should be made until completion of such a 12-month follow-up measurement period.

SOIL

Literature research indicates that the nitroaromatics present in soil which are the source of the carcinogenic risks are susceptible to photolysis. Soil samples collected during this EI from the igloo areas were all collected after removing an overlying vegetation layer. The presence of the vegetative cover inhibits photolysis of these compounds by preventing their exposure to

sunlight. Removal of the vegetative cover, and maintaining the areas around the igloos as denuded soil by periodic rototilling, would facilitate natural photolysis of these compounds. Methods other than rototilling should also be explored to break up soil lumps in order to maximize the surface-area-to-volume ratio, and hence speed the photolysis to completion if remediation of soils is to be undertaken.

Little is known about the rate of photolysis of these nitroaromatic compounds. Prior to undertaking such an in-place photolytic remediation program, further literature or bench-scale research on reaction rates may be necessary in order to ascertain the duration of such a program. Alternatively, pilot-scale implementation of such an alternative technology program could be implemented, with proper routine sampling to generate empirical data on rates of reaction experienced in the field. Regardless of approach, limited further sampling during remediation (if any is to be undertaken) would be necessary to establish both the horizontal (areal) and vertical extent of soil contamination by these nitroaromatic compounds.

All igloo soil samples during this EI were collected immediately outside the igloo at the discharge point beneath the drainage channel grates affixed to the front wall of the igloo. Each sample submitted for analysis consisted of a composite of two aliquots, one from beneath each grate.

Since no general water service existed at the Annex other than at the bath house, it is unlikely that spillage of powdered materials on the igloo floors were hosed out of the igloos with any frequency. Migration of the contaminants likely occurred through either infrequent flushing of the floors and consequent drainage out the grates, or through sweeping of the floors either into the drainage channels and along the channels to the grates, or along the floors and out the igloo entrance and onto the pad, and then to the soils. The actual means of migration to the exterior soils could dramatically impact the horizontal extent of contamination. Collection of limited samples of soil at various locations in front of the identified igloos is recommended during remediation (if any is undertaken) to ascertain the areal extent of soil contamination.

Although literature research indicates the nitroaromatics found in soils at the site have limited mobility in soil, collection of samples at several deeper depths is also recommended during remediation (if any is to be undertaken). All soil samples collected during the EI were from the 0-6 inch soil profile. Samples from the 12-18 inch, 18-24 inch, and 24-30 inch soil regimes should be collected and analyzed, in addition to those from the 6-12 inch regime, in order to ascertain depth of the soil which needs to be remediated. Depth, and hence volume of contaminated media, along with reaction rates, will weigh heavily on determination of treatment duration.

Alternatively, if remediation of soils is to be undertaken, the soils could be excavated and run through an ultraviolet irradiation treatment train to achieve the desired photolytic reaction. This approach would also be very dependent on size reduction methodology in order to maximize the surface area to volume ratio of the soils fed through the treatment train. This treatment train approach, in contrast to natural photolysis, offers increased control of reaction rates through variation of the ultraviolet irradiation dose. Several irradiation methods are available, including arrays of ultraviolet light banks and solar collectors/concentrators.

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

The Department of the Army, United States Army Toxic and Hazardous Materials Agency (USATHAMA), has issued Task Order No. 4 under contract DAAA15-90-D-0013 to Jacobs Engineering Group Inc., entitled "Coosa River Storage Annex Environmental Investigation." The Environmental Investigation of this facility was conducted under the provisions of the Base Realignment and Closure Act. This report presents the findings and conclusions of that Environmental Investigation (EI).

In general, Task Order No. 4 includes the development of planning documents for and the initial activities of an EI of the site. Briefly, this work includes: (1) evaluation of the potential for current and previous activities at the Annex to have caused environmental contamination; (2) development of sufficient information to adequately assess the health and environmental risks associated with the closure and transfer of the Annex for other use; and (3) identification of preliminary remedial alternatives to the level necessary for the Army to make a decision regarding preparation of the property for release.

The scope of work under this EI involved implementation of a Technical Plan and a Sampling Design Plan (hereafter collectively referred to as the "Technical Plan") [Dames & Moore, 1990] as summarized below:

- o Collection and analysis of soil, surface water/sediment, wipe, and radon samples from areas previously identified to be potential contamination sources; and
- o Collection and analysis of soil and surface water/sediment samples to define background levels of potential contaminants of concern.

It should be noted that the following activities were outside the scope of this investigation as tasked by USATHAMA, and hence were not conducted:

- o comprehensive biological inventory, consisting of sampling and detailed taxonomic studies of species, including endangered species, present at the Annex;
- o identification, sampling and inventory of PCB-containing capacitors and transformers;
- o sampling of utility buildings or any structures for asbestos containing materials (ACM);
- o sampling of surfaces of utility building or any structures (e.g., storage igloos, loading ramps) for paint containing lead or mercury;

- o radon sampling of the five utility buildings;
- o investigation of the Brecon Landfill;
- o geophysical survey of the 21 identified ground disturbances;
- o soil gas survey of septic tank tile field or in the area of the previously removed gasoline underground storage tank (UST) and other previously removed USTs;
- o air sampling other than radon at the storage igloos;
- o groundwater evaluation and sampling;
- o biota sampling; and
- o stream flow measurements.

1.2 SITE BACKGROUND AND HISTORY

The Coosa River Storage Annex (the Annex) is located approximately four miles northeast of the City of Talladega, which is geographically located in the north-central portion of Talladega County in north-central Alabama. The Talladega National Forest is located approximately two miles southeast of the Annex.

The Annex is a satellite sub-installation of the Anniston Army Depot (ANAD). The 2,836 acre Annex site contains 136 standard ammunition storage igloos, two covered railcar loading platforms, three uncovered railcar loading platforms, and five small utility buildings. Approximately 1,125 acres is used for storage and contains all 136 storage igloos. Two cemeteries are included in this portion of the property, as illustrated on Figure 1-2. Both cemeteries are inactive. The remaining 1,711 acres is a buffer zone that surrounds the eastern, western, and northern sides of the storage area.

The Annex was established as part of the Coosa River Ordnance Plant (CROP) in 1943 on land purchased by the U.S. Government from several private owners between 1941 and 1943. From 1943 to 1947, the CROP was operated by the Brecon Loading Company. The Brecon Loading Company received powder by rail from the Alabama Army Ammunition Plant (AAAP) in Childersburg, Alabama, and loaded it into propelling charge containers. Nitroaromatics -- including nitrocellulose, trinitrotoluene (TNT), dinitrotoluene (DNT), and tetryl -- were produced at the AAAP.

Following World War II, the CROP and AAAP were deactivated. In October 1946, the Annex, the northern part of the CROP facility which contains the igloo area, was assigned to ANAD, located approximately 12 miles north of the Annex. In 1947, the southern portion of

the plant, which contained all the ordnance assembly operations, was sold to the Coosa Valley Development Corporation.

From 1947 until early 1982, ANAD used the 136 storage igloos at the Annex as overflow storage space for many types of containerized explosives, propellants, and projectiles such as rockets and mortar rounds. Because containerized explosives and propellants were packaged for shipping, it is highly unlikely that any spillage of the materials occurred during storage or handling at the Annex. Nitroaromatics, including the following, are typical components of these types of explosives:

- o 2,4-Dinitrotoluene (2,4-DNT)
- o 2,6-Dinitrotoluene (2,6-DNT)
- o 2,4,6-Trinitrotoluene (2,4,6-TNT)
- o Nitrocellulose (NC)
- o Nitroglycerine
- o Picric acid (2,4,6-Trinitrophenol)
- o Cyclotetramethylene tetranitramine (High Melting Explosive - HMX)
- o Cyclotrimethylene trinitramine (Royal Demolition Explosive - RDX).

Inert parts -- such as bomb fins, wooden boxes, and empty cartridges -- were also stored within the igloos at the Annex. No liquid propellants, chemical weapons, or radiological materials are believed to have been stored at the Annex. In October 1982, the storage of explosives of all types was discontinued at the Annex. Each storage igloo was inspected at that time to ensure that all explosives had been removed [Dames & Moore, 1990].

According to the inspection conducted as part of the Enhanced Preliminary Assessment [Weston, 1989], 76 of the igloos are currently used in some capacity -- 38 igloos by ANAD, and 38 by the Alabama National Guard (ANG) -- to store inert materials consisting of crated bomb fins, empty ammunition cases, empty mortar shell containers, and empty rocket cases. Sixty (60) igloos are known to be empty and dry. Of the 136 igloos, the contents of three igloos are unknown.

In 1973, the western boundary area of the Annex was used by Talladega County as a sanitary landfill. Ownership of this land was officially transferred to the County in 1976. Prior to 1973, this excessed land was reportedly undeveloped and not used for waste disposal [Weston, 1989].

In July 1985, the ANG entered a 5-year agreement with ANAD and began use of the Annex for materials-handling exercises with inert materials. Fort McClellan Army Base in Anniston, Alabama, has also occasionally used the Annex as a training area. The Fort's activities have involved airlifting an abandoned bus and an abandoned airplane in the area around Igloo 3101.

The current status of the Annex is similar to the original facility. The 136 igloos are still present and intact. No live ammunition is known to be stored on-site. Other than the 136 igloos, five utility buildings are present at the Annex: S-1, a small office building located by the southern gate; S-2, another office building located north of S-1; S-3, a sentry post located at the northern gate; S-4, a sentry post located at the southern gate; and a new troop bathhouse built in 1987 in the vicinity of buildings S-1 and S-2. No buildings predating construction of the Annex are known to remain. Five railcar loading ramps are present at the Annex. The only transformer at the Annex was installed in 1988 and is owned by the Alabama Power Company, whose records indicate that the transformer contains no polychlorinated biphenyls (PCBs). The southern cemetery is completely inactive. The northern cemetery, adjacent to the former Providence Baptist Church, has not been used for burial in over 20 years. Access for visitation to this cemetery is arranged through ANAD. Security is provided by a 6 ft chain link fence with three strands of barbed wire around the 1,125 acre storage area; except for entry and egress passage, the access gates are kept locked at all times. Daily security inspection is provided by ANAD. The 1,711 acre buffer zone has some fencing, but is essentially unsecured.

Table 1-1 contains a synopsis of pertinent property information, and Table 1-2 contains a summary of the history of the Annex, while Figure 1-1 illustrates the geographic location of the Annex and Figure 1-2 shows the current and historical facility boundaries.

1.3 REGULATORY HISTORY

No environmental permits are known to exist for the Annex. Neither the U.S. Environmental Protection Agency (U.S. EPA) Region IV nor the Alabama Department of Environmental Management (ADEM) has any information related to the facility [Weston, 1989]. The Annex is not subject to any existing Federal facility agreement (FFA) between the U.S. Army, the U.S. EPA and the ADEM.

In December 1988, the Defense Secretary's Report on Base Realignment and Closure recommended the closure of the Coosa River Storage Annex. USATHAMA was assigned the responsibility for centrally managing the closure.

Since 1989, USATHAMA has initiated four studies prior to this EI to evaluate the installation from the perspective of property transfer, to identify areas of potential environmental concern at the Annex, and to indicate which areas of the installation may be releasable without any further work [Weston, 1989].

In September 1989, the U.S. EPA's Environmental Photographic Interpretation Center (EPIC) completed an Installation Assessment of the Annex for USATHAMA as part of the Army Base Closure Program [EPIC, 1989].

In December 1989, Roy F. Weston, Inc., performed an Enhanced Preliminary Assessment (PA) for USATHAMA [Weston, 1989]. This study identified areas where contamination may exist as the result of previous or ongoing activities at the Annex and assessed the potential impact of these areas on the surrounding environment.

In June 1990, Dames & Moore prepared a Draft Final Technical Plan, Draft Final Sampling Plan, and Draft Final Health and Safety Plan [Dames & Moore, 1990] for an Environmental Investigation of the Annex. Additionally, three underground storage tanks (USTs) were removed by ANAD in 1990.

These actions are discussed further in the following sections.

1.3.1 AERIAL IMAGERY ANALYSIS

In 1989, EPIC provided imagery analysis of aerial photographs of the Annex for USATHAMA [EPIC, 1989] as part of the Army Base Closure Program. The purpose of this study was to obtain, analyze, and provide aerial photographic coverage of the Annex from 1937 to 1983. The analysis was to concentrate on manmade features that may have caused the alteration of groundwater or surface water quality.

The assessment identified numerous areas where excavation, grading, and ground scars were present at the Annex. These areas were not believed to be associated with the construction and maintenance of the storage igloos. Three ponds were also identified, along with the location of a possible vertical tank. A fenced, rectangular area containing light-toned objects and a possible pit was also identified by the investigation. These areas were highlighted as potential areas of waste disposal, though no positive evidence of such activity was noted [EPIC, 1989].

1.3.2 ENHANCED PRELIMINARY ASSESSMENT

In 1989, Roy F. Weston, Inc. conducted an Enhanced Preliminary Assessment (PA) for USATHAMA [Weston, 1989] to identify present and past operations at the Annex that may have environmental impacts. To assess the site, Weston conducted a records search; interviewed former employees; and contacted Federal, State, local, and private personnel who

might have knowledge of the site. The EPIC installation assessment [EPIC, 1989] was also reviewed for this study, and a site reconnaissance was performed. No environmental samples were collected. However, results of asbestos sampling conducted at two buildings at the Annex by the U.S. Army Corps of Engineers (USACE) at the request of ANAD are presented in the PA.

Based on the results of the investigation, 21 possible waste disposal areas associated with ground disturbances and four excavated ponds were identified. Additionally, two loading ramp areas, a debris pile, all 136 storage igloos, four USTs, asbestos siding on a small office building (building S-1), and asbestos tile in a sentry post (building S-3) were identified as being areas of potential environmental concern. The Brecon Landfill, located east of Jackson Trace Road on property previously exscessed from the Annex, was identified as a potential source of groundwater contamination along the western border of the site.

A preliminary evaluation of the known or suspected releases from each of these areas of potential environmental impact was performed, and potential pathways for contaminant release were identified. A limited sampling program was recommended to evaluate whether contamination was present where ground disturbances were noted -- in and around the igloos, in the excavated ponds, in the vicinity of the loading ramps, and at the debris pile. The PA report notes that these sampling recommendations were based largely on the possibility of past spills or on-site waste disposal rather than field observations or reported history.

1.3.3 REMOVAL OF GASOLINE UST

One 3,000-gallon UST, located north of building S-1, was used to store leaded gasoline. This tank is believed to have been installed during the construction of the Annex. The UST was last used in 1981. In 1985, the tank was pumped dry and the dispensing pump was removed. The fuel dispenser was positioned directly over the UST; no fuel line trenches were present. On January 24, 1990, the tank was removed and taken to ANAD. The tank was reported to be partially filled with water at the time of removal. Upon removal, several small holes, possibly caused by corrosion, were observed in the bottom of the tank. Soil samples were collected from each side of the excavation and from soil beneath the bottom center of the tank, in accordance with ADEM procedures. These three samples were analyzed by the U.S. Army Corps of Engineers South Atlantic Division Laboratory, Marietta, Georgia, using U.S. EPA Method 418.1 (IR Method), Total Recoverable Petroleum Hydrocarbons (TRPH). TRPH concentrations in the soil samples collected from the east and west sides of the excavation were found to be 432 milligrams/kilogram (mg/kg) and 447 mg/kg, respectively, while that in the soil sample collected from the bottom center of the excavation was determined to be 432 mg/kg [Dames & Moore, 1990]. The ADEM was notified of this UST leak, and issued

incident number UST 90-5-20 after reviewing the UST closure report; the facility number assigned to the site is 10267-015-003643 [Geraghty & Miller, 1991b].

The Army investigated soil and groundwater contamination resulting from this leak in a Preliminary Investigation performed by Geraghty & Miller, Inc. during July 1990. Four soil borings were installed to a depth of 20 ft placed at equally spaced intervals approximately 5 ft from the tank location in the corners of the UST excavation. Soil samples were collected at 5-ft intervals, at depths of 5, 10, and 15 ft below land surface (bls). Soil samples were analyzed for Total Petroleum Hydrocarbons (TPHC) using U.S. EPA Method 9071 (Standard Method 503E-IR). Measurable quantities of TPHC were not detected in any of the soil samples collected. Ground water, observed seeping into the two borings on the south side of the tank excavation, was sampled and found to contain concentrations of 41 micrograms/liter (ug/L) and 89 ug/L, respectively, of total benzene, ethylbenzene, toluene, and xylenes (BETX). Neither sample contained measurable concentrations of dissolved lead. Free-phase product was not observed in the borings [Geraghty & Miller, 1990].

ADEM subsequently issued ANAD a Notice of Violation which required further site evaluation to assess the vertical and horizontal extent of contamination. Geraghty & Miller performed a Secondary Site Assessment in accordance with the Work Plan for Secondary Site Assessment [Geraghty & Miller, 1991a], which was approved by the ADEM on February 28, 1991 [Geraghty & Miller, 1991b].

Five soil borings were drilled for the purposes of soil sampling and monitor-well installation during the Secondary Site Assessment. Nominal 6-inch diameter borings were drilled to a depth of approximately 21 ft; the boring for monitor well MW-1D was drilled to a depth of 31 ft. Soil samples were collected by split spoon sampler at 5-ft intervals; the boring for MW-1D was continuously sampled to more accurately define subsurface stratigraphy. MW-1 was not sampled due to its close proximity to MW-1D [Geraghty & Miller, 1991b].

Soil samples were collected for headspace screening using an organic vapor analyzer (OVA) to measure concentrations of volatile organic chemicals (VOCs) relative to the calibration gas isobutylene standard of 100 ppm. OVA measurements ranged from 0 to 26 ppm. Selected samples from each boring were submitted for laboratory analyses of Total Petroleum Hydrocarbons (TPHC) using U.S. EPA Method 503E. TPHC was detected in each soil sample analyzed, at concentrations ranging from 10 to 22 mg/kg. The highest TPHC concentration was detected in a soil sample collected from a depth of 20 to 22 ft in boring MW-1D, located approximately 20 ft northeast of the UST excavation [Geraghty & Miller, 1991b].

The unconsolidated material encountered during drilling consisted of tan to purple clayey, sandy silt with shale fragments, minor amounts of silty, clayey sand, and tan to purple shale displaying various stages of weathering. Consolidated bedrock was not encountered during drilling to a maximum depth of 31 ft [Geraghty & Miller, 1991b].

Each borehole was completed as a groundwater monitor well immediately upon completion of drilling. Monitor wells were constructed with 2-inch inside diameter flush threaded, 0.010-inch slotted, Schedule 40 PVC screens and risers. Monitor wells MW-1, MW-2, MW-3 and MW-4 were constructed with 15-ft sections of well screen extending from a depth of 3 to 18 ft, while MW-1D was constructed with a 5-ft section screen extending from a depth of 26 to 31 ft. Risers were used to complete the wells to above ground surface [Geraghty & Miller, 1991b].

Rising head hydraulic conductivity tests using displacement slugs to estimate aquifer characteristics were performed in MW-1D and MW-4. A hydraulic conductivity value was calculated from the data using the Bouwer and Rice methodology [Bouwer and Rice, 1976]. Results of the analysis estimate the hydraulic conductivity of the unconfined water-bearing units (sandy silt, weathered shale) at approximately 2.0×10^{-4} cm/sec and 2.8×10^{-5} cm/sec in the vicinity of MW-1D and MW-4, respectively. These values are generally considered typical estimates of hydraulic conductivity for fine-grained water-bearing sandy-silt and weathered shale [Geraghty & Miller, 1991b].

Water levels, measured in all monitor wells on 3 May 1991, prior to collection of groundwater samples, ranged from 2.13 to 3.95 ft bsl. The water table contour map generated from these measurements suggests that the horizontal direction of shallow groundwater flow is toward the northeast at an average gradient of 0.015 ft/ft (0.015 cm/cm). Using this gradient, the hydraulic conductivity for MW-1D, and an assumed effective porosity of 20% which is representative of sandy silt, results in an estimated groundwater velocity of 0.04 ft/day (1.5×10^{-5} cm/sec), as calculated using Darcy's law [Geraghty & Miller, 1991b].

Groundwater samples were collected by means of a Teflon bailer on 3 May 1991. No free-phase hydrocarbons were detected in any monitor well [Geraghty & Miller, 1991b]. All groundwater samples were analyzed for BETX and methyl tertiary butyl ether (MTBE) using U.S. EPA Method 602, and for total lead using U.S. EPA Method 239.2, in accordance with the Sampling Plan included in the Work Plan for Secondary Site Assessment [Geraghty & Miller, 1991a].

Lead was detected in each groundwater sample, with the exception of MW-4, at concentrations ranging from 2 ug/L to 7 ug/L. MTBE was not detected in any of the groundwater samples. Benzene and xylenes were detected only in MW-1D at concentrations of 1 ug/L and 2 ug/L, respectively. Toluene was detected at concentrations ranging from 6

ug/L to 10 ug/L in MW-1D, MW-2, MW-3, and MW-4. However, toluene was also detected in the trip blank and field blank samples at 7 ug/L and 9 ug/L, respectively. Total BETX concentrations range from below detection limit at MW-1, to 11 ug/L [Geraghty & Miller, 1991b].

In summary, because all hydrocarbon constituents in soil and ground water were detected at concentrations below State of Alabama corrective action levels, ADEM concluded that "no further investigative or corrective actions will be required for this site at this time" [ADEM, 1991].

1.3.4 TECHNICAL PLAN

In 1990, Dames & Moore conducted a planning study on behalf of USATHAMA which resulted in the development of the Draft Final Technical Plan, Draft Final Sampling Plan, and Draft Final Health and Safety Plan [Dames & Moore, 1990]. These documents assess the physical and environmental status, describe additional data needs, and propose sampling requirements which are the basis for the field investigation portion of this Environmental Investigation.

The numbers assigned to the loading ramps in this EI Report were determined from a 1984 map of the Annex by the U.S. Army Corps of Engineers (USACE), Mobile District, obtained from ANAD during the field investigation [USACE, 1984].

Ramps 3404, 3405 and 3408 are properly identified on that map. The ramp west of Igloo 2308 is illustrated on that map, although it is identified as 3407. No ramp is illustrated north of Igloo 1904 on that map. Examination of that map indicates that the ramps are numbered sequentially in a counterclockwise direction around the railroad spur. Hence, the ramp west of Igloo 2308 is identified in this report as loading ramp 3406, and the ramp north of Igloo 1904 is identified in this report as loading ramp 3407. Table 1-3 presents a comprehensive listing of all loading ramps and igloos present at the Annex (as identified at the completion of the field investigation of this EI).

The numbers assigned to the roads in this EI Report were determined from a 1942 War Department map of the facility produced by Weideman and Singleton Engineers [War Department, 1942]. Table 1-4 presents a summary of the roadway nomenclature used in this report, based upon that map and cross-referenced to the nomenclature used in previous reports, and a description of the roadway and its main features. The locations of the loading ramps and roads are illustrated on Figure 3-1.

The following subsections present the findings of the Technical Plan, organized by major site features.

1.3.4.1 Features Not Recommended For Further Study

1.3.4.1.1 Utility Buildings

Five buildings other than the storage igloos are present at the Annex, as shown on Figure 3-1. Building S-1 (a small office building), building S-2 (located across the road and north of S-1), and a new bathhouse built in 1987 are all located along road M-1 at the southern boundary of the Annex west of the railroad track near the southern gate. The bathhouse required the installation of electrical, municipal water, and sewer utilities at the Annex for the first time. (Prior to this construction, a septic system was used.) These buildings appear to be in good condition. Two above-ground propane tanks were noted in the Technical Plan: one tank provided fuel for the bathhouse, and the other tank supplied fuel to building S-2 [Dames & Moore, 1990]. These tanks are no longer present in the area. A fourth building, building S-3, is a small sentry post (10 ft by 10 ft in plan view) located at the north gate, the intersection of P-3 and M-2 (identified as R15 in previous reports). It has been heavily vandalized. The fifth building, building S-4, is a small sentry post, similar to S-3, located at the south gate along road M-12 near the intersection with road M-1.

An asbestos survey of the Annex was performed in 1989 by the USACE South Atlantic Division Laboratory, Marietta, Georgia, at the request of ANAD. Buildings S-1 and S-3 were identified in the Enhanced PA [Weston, 1989] as having materials containing asbestos. The floor tile in building S-3 was sampled by the USACE and found to contain between 2 and 5 percent chrysotile. No asbestos was detected by the USACE in the sheet rock in building S-1; however, the one sample collected from the siding of this building by the USACE was found to contain between 20 and 30 percent chrysotile. The siding of building S-1 is in good condition and is nonfriable. Under current conditions, the presence of this asbestos does not appear to pose any health risk. However, if the buildings are demolished, these materials may have to be handled and disposed of separately, and it may be necessary to assess the potential risks posed to demolition workers. Based on the construction of the other buildings at the Annex, it is believed that building S-2 and the bathhouse do not contain asbestos [Dames & Moore, 1990]. No further asbestos survey work of any buildings at the Annex was performed as part of this Environmental Investigation.

The potential accumulation of radon gas in these buildings does not appear to be a hazard given the type of geology in the area and the well ventilated construction of these buildings. No other potential contaminants are believed to be associated with the building structures at

the Annex [Dames & Moore, 1990]. Investigation of these buildings was beyond the scope of this Environmental Investigation.

1.3.4.1.2 Underground Storage Tanks

Four USTs have been present at the Annex. One UST, located south of road M-1 and north of building S-1, was used to store gasoline. The Enhanced PA indicates its capacity as 500 gallons [Weston, 1989], while another report prepared during the removal of the UST indicates its capacity as 3,000 gallons [Geraghty & Miller, 1990]. It is believed that this tank was installed during the construction of the Annex. The tank was pumped dry in 1985, and the dispensing pump was removed. In 1990, the tank was transported off-site by ANAD [Dames & Moore, 1990].

Two USTs containing liquified propane (LP) gas were removed by ANAD in 1990, and the excavations were backfilled with sand, rock, and native clay. No staining was observed during the removal of these LP tanks. If leaks had occurred during operation of the tanks, the gas would have been emitted to the atmosphere. One of the tanks serviced building S-3, the sentry post by the north gate, and was located inside the fence approximately 25 ft southwest of the building. The other tank supplied building S-1 and was located approximately 20 ft south of the southeast corner of the building. These tanks are also believed to have been installed during the construction of the Annex [Dames & Moore, 1990].

The fourth UST is a septic tank that received sanitary sewage from building S-1. The tank was abandoned in 1987 when the bathhouse was built [Dames & Moore, 1990].

The U.S. Army has addressed the excavated gasoline UST as separate actions independent of this EI (see Subsection 1.3.3 above). Investigation of the USTs was therefore beyond the scope of this EI.

1.3.4.1.3 Brecon Landfill

The Brecon Landfill is located in the northwestern portion of the property exceded to Talladega County in 1976. The landfill is currently operated as a transfer station for inert household wastes, but does allow some dumping of larger inert wastes, such as lumber, tires, and plastic. The landfill appears to be near capacity, and the majority of the site is covered with grass. A small stream, which flows from the Annex, crosses the northeastern corner of the landfill.

Based upon the topographic maps of the area, the Technical Plan [Dames & Moore, 1990] concluded that sufficient information appears to show that groundwater flow occurs from the Annex toward the Brecon Landfill. Therefore, USATHAMA has interpreted that the Annex is unlikely to be impacted by the landfill [Dames & Moore, 1990]. Investigation of the landfill or of groundwater flow was not recommended for further study, and hence were beyond the scope of this EI.

1.3.4.1.4 Groundwater

Groundwater is the exposure pathway of greatest potential concern at the Annex, because it is the major source of local drinking water. However, the Technical Plan determined that it is unlikely that activities conducted at the Annex could have impacted groundwater quality in the area [Dames & Moore, 1990], and therefore concluded that investigation of groundwater was not recommended for further study. Hence, investigation of groundwater was outside the scope of this EI. Refer to Subsection 2.6 of this EI Report for further information on this pathway.

1.3.4.2 Features Recommended For Further Investigation

1.3.4.2.1 Storage Igloos

The 136 concrete storage igloos at the Annex are Quonset hut-shaped. Figure 3-1 shows their locations and building numbers, while Table 1-3 presents a comprehensive listing of the igloos present at the Annex. Each igloo is covered with earth, so that only the front semicircular side is exposed.

The dimensions of the igloos are given in the Technical Plan as approximately 80 ft by 25 ft, with a maximum interior height of approximately 17 ft. However, the "as built" map of the Annex [War Department, 1942] obtained during the EI gives actual cumulative square footages for igloo rows. By examining those entries which consist of only two igloos, the EI Contractor has determined that two separate igloo sizes exist: a "standard" igloo of 2,718.5 ft², and a "small" igloo of 1,869 ft². The dimensions of the standard igloo are estimated by the EI Contractor at 30 ft in width x 90 ft in length x 17 ft interior height; those for the "small" igloo (Igloos 3301 and 3302 only) are estimated at 30 ft in width x 60 ft in length x 17 ft interior height.

Each igloo has a concrete floor, and two shallow drainage channels run the length of the igloo along each side. These channels lead to two screened drains located along the front wall,

which discharge to the surficial soils in front of each igloo. Ventilation is provided by an air vent on the door and a chimney near the rear of the structure. Unpaved, gravel surfaces are present in front of each igloo and provide access from nearby roads.

The inspection of the igloos performed as part of the Enhanced PA [Weston, 1989] indicated that most of the igloos were clean, dry, and free of floor cracks. As discussed previously, some of the igloos are currently used to store inert materials such as bomb fins, pallets, mortar shell cases, etc., though inventory records present within the igloos indicate that none of the contents have been stored in their current locations for more than 25 years. During the Annex's operation by the Brecon Loading Company, it is likely that bagged explosives and propelling charge containers were stored in the igloos. From 1947 to 1982, containerized explosives, propellants, and projectiles, as well as inert materials, were stored in the igloos by ANAD.

Based on a review of the historical information for the Annex, the storage igloos were used to store explosives, propellants (nonliquid), and a variety of inert materials. Given the use of these igloos, potential contaminants appear to be nitroaromatics and metals associated with the explosives and propellants which came from the Alabama Army Ammunition Plant and were stored at the Annex from 1941 to 1947. Table 1-5 lists the individual nitroaromatics and the metals that may have been handled at the Annex from 1941 to 1947. The Enhanced PA [Weston, 1989] identified red stains in Igloos 3301 and 3302, and stained soil -- believed to be from diesel oil -- outside Igloo 1607. During the Technical Plan's site reconnaissance effort, the red staining referenced in the Enhanced PA appeared to be part of a 0.5 inch concrete material that covers the entire floor. This floor covering may be a conductive surface, often used in structures in which explosives are handled, and the red coloring did not appear to be the result of a spill. Small oil stains observed to be present in Igloos 1910, 2007, 2904 and 3108 are likely associated with moving equipment; however, the potential exists that these oils may contain polychlorinated biphenyls (PCBs) [Dames & Moore, 1990].

Given the construction of the igloos, there is the potential for radon gas to be present within the structures. However, the potential for radon gas to be a significant health risk appears to be minimal because the igloos are vented, are not occupied by personnel, and the geology in the area does not appear to be related to igneous rocks from which high natural radon levels occur [Dames & Moore, 1990].

Because the igloo floors are cement, clean, dry and free of cracks, and because no liquids are reported to have been stored in the igloos at the Annex, any spillage would likely have been swept up and disposed. The soil outside the entranceway to the igloo is the probable point of release for any contamination swept out of an igloo. Other potential pathways for release would be through the drain trenches which are sloped to discharge to the surface soil at the

front two corners of each igloo. However, it is unlikely that the igloo floors have ever been rinsed because no water service of any kind existed at the Annex until the construction of the troop bathhouse in 1987.

1.3.4.2.2 Loading Ramp Areas

The Enhanced PA identified two railcar loading ramp areas at the Annex [Weston, 1989]. Loading Ramp 3405, as identified in this report and on both the 1942 War Department map and the 1984 USACE map, although identified as 3403 in the Enhanced PA [Weston, 1989] and in the Technical Plan [Dames & Moore, 1990], is located on the west side of road M-24 west of Igloo 2605. Loading Ramp 3408, as identified in this report, both previous reports, and on both the 1942 War Department map and the 1984 USACE map, is located south of Igloo 1804 on the east side of road M-6 (identified as R5 in previous reports).

A third loading ramp, identified as 3404 in the Technical Plan, and in this EI Report, and on both the 1942 War Department map and the 1984 USACE map, was discovered along road M-24 south of Loading Ramp 3405 and west of Igloo 2602 during the Technical Plan site reconnaissance effort [Dames & Moore, 1990].

Two additional loading ramps were discovered during the field investigation effort of this EI. One, identified in this EI Report as Loading Ramp 3407, is located north of Igloo 1904 on the east side of road M-7 (identified as R6 in previous reports). This loading ramp is illustrated on the 1942 War Department map but not identified and is neither illustrated nor identified on the 1984 USACE map. The second, identified in this EI Report as Loading Ramp 3406, is located west of Igloo 2308 on road M-10 near its intersection with M-11 (identified respectively as R9 and R10 in previous reports). This loading ramp is identified as 3407 on both the 1942 War Department map and the 1984 USACE map.

Examination of the 1984 USACE map indicates that the ramps are numbered sequentially in a counterclockwise direction around the railroad spur. Table 1-3 explains the individual loading ramp numbers by row. The numbering of Loading Ramps 3404, 3405 and 3408 agrees between the 1942 War Department map and the 1984 USACE map. Hence, the ramp west of Igloo 2308 is identified in this EI Report as Loading Ramp 3406, being the first ramp counterclockwise from 3405; the ramp north of Igloo 1904 is identified in this EI Report as Loading Ramp 3407, being the second ramp counterclockwise from 3405 and immediately preceding 3408.

Each of the loading ramps is constructed of concrete; Loading Ramps 3404 and 3405 have metal roofs. Table 1-6 provides a summary of the locations and characteristics of each loading ramp.

Loading Ramp 3404, located south of Loading Ramp 3405 on road M-24, is a metal-roofed concrete platform with no distinguishing features. No evidence of recent activity of any sort was observed during either the site reconnaissance effort of the Technical Plan or the field investigation of this EI, and no information was available pertaining to the activities previously conducted at this ramp.

Loading Ramp 3405, located north of Loading Ramp 3404 on road M-24, is a metal-roofed concrete platform with a metal structure of unknown function present. The Enhanced PA and the Technical Plan tentatively identify this structure as a furnace or ash collection vessel of some kind, though the presence of wooden rollers within the unit appears to indicate that it was not a furnace. What is believed to be a large vertical above ground tank surrounded by standing liquid was also observed in a 1949 aerial photograph of this ramp area [EPIC, 1989], though the tank was removed prior to 1954, and no evidence of ground staining was observed during either the site reconnaissance effort of the Technical Plan or the field investigation of this EI. Based upon the operating practices of railroads at the time, the tank likely contained water, and the standing liquid probably also was water. This area is currently used for loading exercises [Dames & Moore, 1990].

Loading Ramps 3406 and 3407 currently exist as unroofed concrete platforms with no distinguishing features. Both were surrounded by tall growths of grass and weeds, which may explain their lack of detection during prior site reconnaissance efforts. No evidence of recent activity of any sort was observed during the field investigation of this EI, and no information was available pertaining to the activities previously conducted at these ramps.

Loading Ramp 3408 also currently exists as an unroofed concrete platform. Gravel has been stockpiled along the western side of the loading dock, and no distinguishing features were observed in the aerial photographs, during the site reconnaissance effort of the Technical Plan, or the field investigation effort of this EI. No information regarding past activities at this platform was available.

There is the potential for spillage of nitroaromatics around the loading ramps during the materials handling conducted in these areas. Due to the volume of materials-handling activities conducted by rail during World War II, which is when the storage igloos of the Annex were most active, these loading ramp areas are the most probable locations of an accidental spill of explosives at the Annex. The structure on ramp 3405 is another potential source area where spills may have occurred. The potential for both nitroaromatics and metals

contamination appears to exist in the soils around the loading ramps as the result of activities previously conducted in the area [Weston, 1989; and Dames & Moore, 1990].

1.3.4.2.3 Debris Pile

Located immediately north of Loading Ramp 3408 on road M-6 (identified as R5 in previous reports) is a pile of debris consisting of packing crates, wooden ammunition boxes, pallets, cylindrical mortar shell cases, and paper trash [Weston, 1989]. This pile measures approximately 50 ft by 25 ft. Some of the mortar cases are reportedly covered with Cosmoline, which is a VaselineTM-like corrosion-inhibiting paste. Although the pile appears to have been present for several years, it is uncertain whether dumping occurred in this area during loading activities at the Annex, and no evidence of such action is visible in this area in the aerial photographs presented in the EPIC report [EPIC, 1989].

It is believed that the wastes currently present have been placed in this area during the past several years. The Enhanced PA [Weston, 1989] indicated that unexploded ordnance may be present in the debris pile. Sergeant Daughtry of the III Ordnance Group, Alabama National Guard, reported that the debris pile consisted of training aids (boxes filled with gravel to simulate ammunition) and no unexploded ordnance is present in the pile [Dames & Moore, 1990]. Based on the wastes placed in the debris pile, potential contaminants include nitroaromatics, metals, and petroleum hydrocarbons.

1.3.4.2.4 Ground Disturbances

The Enhanced PA [Weston, 1989] identified 21 areas of ground disturbance that may have been used for waste disposal. Figure 3-1 shows the location of each of these areas. During the site reconnaissance effort performed as part of the development of the Technical Plan, the majority of the ground-disturbed areas appeared to be old borrow pits that either provided earthen cover for the igloos or provided fill to build roads. No evidence of waste disposal activities was observed at any of the locations [Dames & Moore, 1990]. Table 1-7 provides a summary of the location, dimensions, and distinguishing features of each of the disturbed areas.

The majority of the ground disturbances are now partially or completely re-vegetated, and locating the original boundaries is difficult. The dimensions presented in Table 1-7 were approximated by field observations made during the Technical Plan's site reconnaissance [Dames & Moore, 1990], and from the aerial photographs provided in the EPIC report [EPIC, 1989].

Based on site reconnaissance conducted during preparation of the Technical Plan documents, two of these areas appear to have been mislocated in the Enhanced PA. Area GD-6 is located west of M-5 (identified as R4 in previous reports), rather than west of M-4 (identified as R3 in previous reports) as depicted in the Enhanced PA. During the Technical Plan's site reconnaissance effort, the area west of M-4 (identified as R3 in previous reports) was examined, and little evidence of any ground disturbance was observed. Area GD-19 also appears to have been mislocated in the Enhanced PA. Based on aerial photographs, it appears as though the location should be an excavated area east of Igloo 2605 and east of M-12 (identified as R13 in previous reports) rather than west of M-12 and south of the igloo. This site was not examined during the site reconnaissance under the Technical Plan because of the inaccurate location, though the Enhanced PA location was examined and no evidence of a ground disturbance was observed [Dames & Moore, 1990].

The EPIC assessment [EPIC, 1989] mentions a fenced area near the center of the Annex that contained a possible pit and light-toned objects. Review of topographic maps and examination of this area during the Technical Plan's site reconnaissance effort indicated that it is one of the two cemeteries present on the property [Dames & Moore, 1990].

Based on historical records reviewed as part of the Enhanced PA and the Technical Plan site reconnaissance effort, the ground disturbances do not appear to have been associated with burning or burial activities at the Annex. According to the Enhanced PA, any explosives burning or waste disposal was reportedly conducted at ANAD [Weston, 1989]. However, because little data are available about the disturbed areas at the Annex, the potential exists for these waste disposal activities to have occurred. Because of the nature of materials handled at the Annex, nitroaromatics and metals are the two most probable types of potential contaminants [Dames & Moore, 1990].

1.3.4.2.5 Excavated Ponds

Four ponds were identified in the Enhanced PA [Weston, 1989]. The locations of these ponds are shown on Figure 3-1. Only three of the ponds were identified by the aerial imagery analysis [EPIC, 1989].

The purpose of the ponds is not known, though they may be related to development of the property to accommodate cattle grazing leases granted at the Annex or perhaps used for surface water runoff control. Pond 4, located west of the southern end of B-7 (identified as R19 in previous reports), was observed during the field investigation of this Environmental Investigation to be a low-lying area where water accumulates due to the presence of a beaver

dam. No evidence of excavation was observed in the area of Pond 4. During the site reconnaissance effort of the Technical Plan, evidence of excavation was obvious at the other three ponds [Dames & Moore, 1990]. Table 1-8 provides a summary of the locations and characteristics of each pond.

Based on historical records reviewed as part of the Enhanced PA and the Technical Plan's site reconnaissance effort, the excavated ponds do not appear to have been associated with burning or burial activities at the Annex. According to the Enhanced PA, any explosives burning or waste disposal was reportedly conducted at ANAD [Weston, 1989]. However, because little data are available about these excavated pond areas at the Annex, the potential exists for these waste disposal activities to have occurred. Because of the nature of materials handled at the Annex, nitroaromatics and metals are the two most probable types of potential contaminants [Dames & Moore, 1990].

1.3.4.2.6 Streams

The numerous streams that flow near many of the igloos are sites where potential contamination from activities conducted at the Annex may exist. Although no documented spills or waste disposal occurred in the streams, the potential exists for wastes to have entered into them through runoff. Based on the type of materials handled at the Annex, wastes potentially present in the streams include nitroaromatics and metals [Dames & Moore, 1990].

1.4 REPORT ORGANIZATION

This EI Report for the Coosa River Storage Annex is organized in 8 sections, according to the format suggested in U.S. EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," and is presented in 2 volumes. Volume 1 contains the text of the report along with supporting figures and tables, which are presented at the end of each section; Volume 2 contains the appendices.

Section 1.0 Introduction -- presents a brief introduction to the objectives of the Environmental Investigation, background information on the Annex, including a site description, history, a brief review of previous investigations, and outlines the organization of the report.

Section 2.0 Physical Characteristics of Study Area -- presents information on the environmental setting of the Annex, including surface features, geology, hydrogeology, and land usage.

Section 3.0 Study Area Investigations -- summarizes various investigatory activities performed during the EI.

Section 4.0 Nature and Extent of Contamination -- presents quantitative chemical and physical characteristics of the environmental media sampled at the Annex.

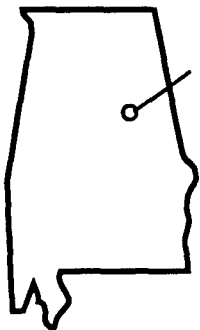
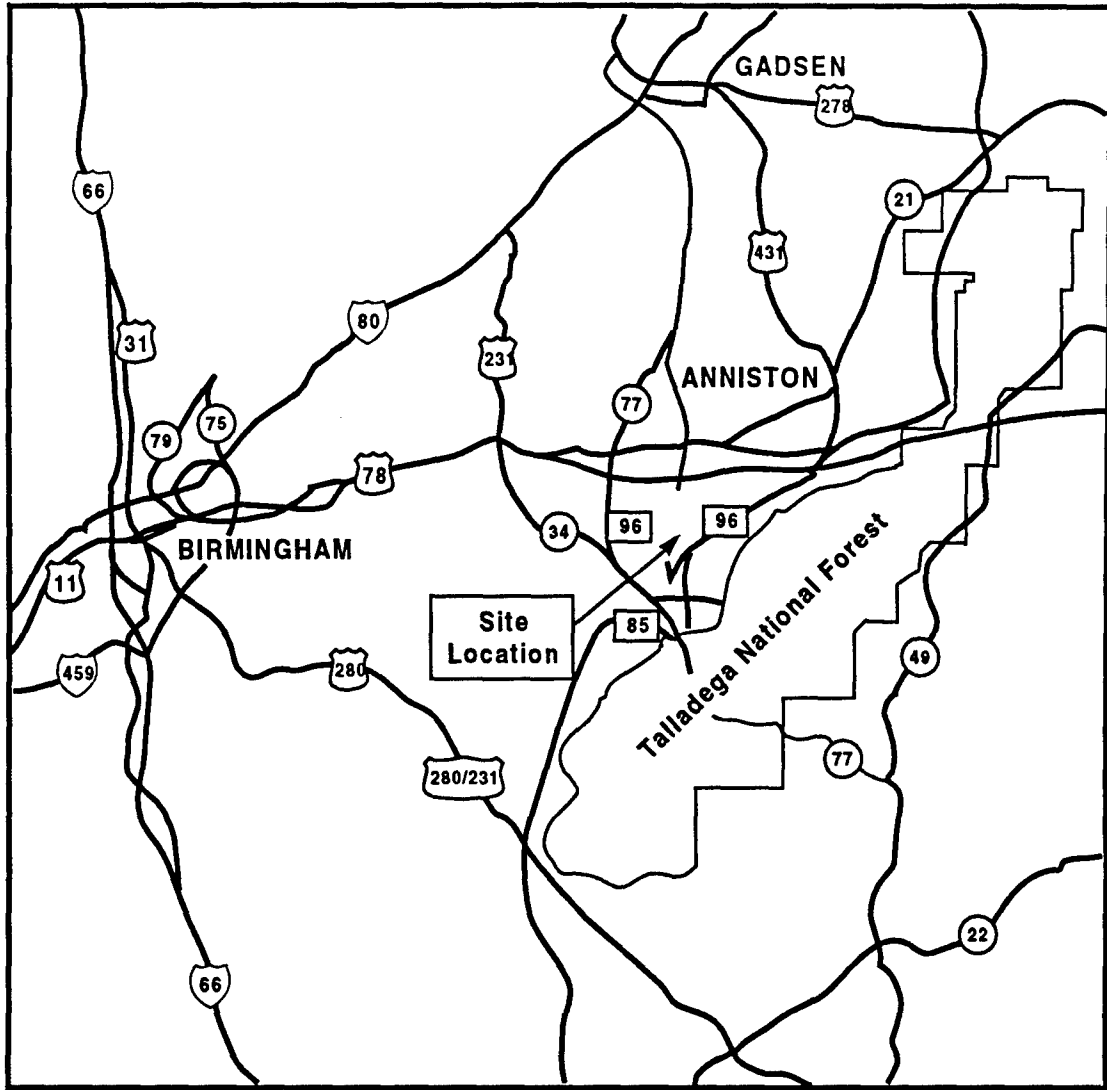
Section 5.0 Contaminant Fate and Transport -- addresses the environmental fate of detected contaminants and the potential for migration.

Section 6.0 Baseline Risk Assessment -- evaluates the potential or actual endangerment to public health and the environment due to contamination at the Annex.

Section 7.0 Preliminary Remedial Action Objectives and Alternatives -- summarizes findings of the baseline risk assessment, and presents preliminary remedial objectives and preliminary remedial alternatives.

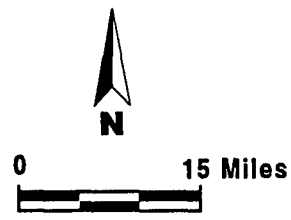
Section 8.0 Summary and Conclusions -- summarizes findings of the EI.

Section 9.0 References Cited -- presents a compilation of references cited.



COOSA RIVER STORAGE ANNEX


ALABAMA



DRAWN	KRL
CHKED	
APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

FIGURE 1-1
LOCATION MAP
COOSA RIVER STORAGE ANNEX EI

JE JACOBS ENGINEERING GROUP INC. No. G304R11

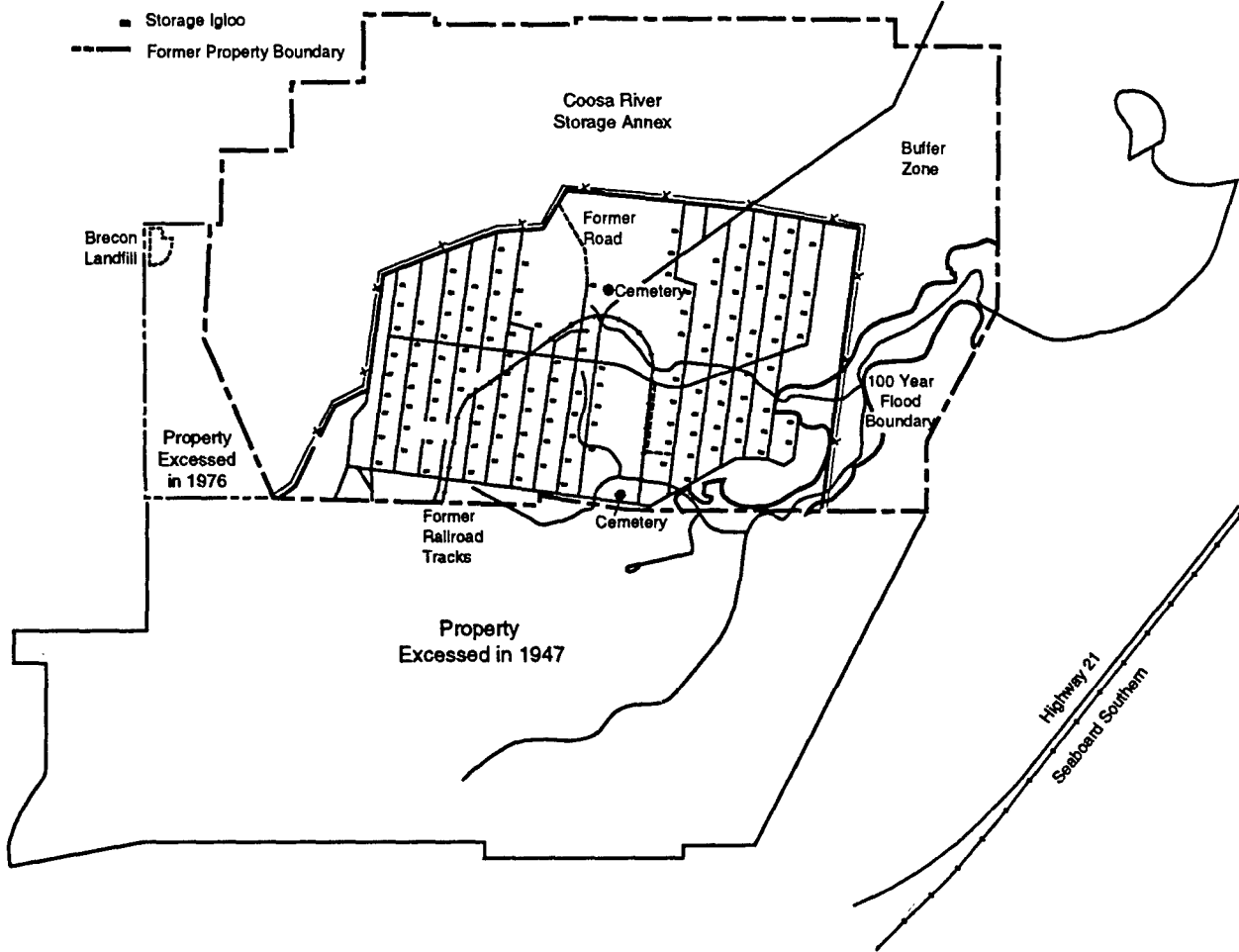
 **US Army Corps of Engineers**
 Toxic and Hazardous Materials Agency
 Contract No. DAAA15-90-D-0013-0004

LEGEND

- Property Line
- x- Fence
- Gravel Road
- Railroad
- Storage Igloo
- Former Property Boundary



Not to Scale



Source: Weston, 1989


DRAWN	KRL
CHKED	
APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

FIGURE 1-2

SITE PLAN

COOSA RIVER STORAGE ANNEX EI

JE JACOBS ENGINEERING GROUP INC. No. G304R12



US Army Corps of Engineers

Toxic and Hazardous Materials Agency

Contract No. DAAA15-90-D-0013-0004

TABLE 1-1

PROPERTY INFORMATION SUMMARY

Name: Coosa River Storage Annex

FFIS Number: AL-213820231

IRDMIS Installation Code: CX

Property Number: 01012

Command: Depot Systems Command (DESCOM)

County: Talladega

State: Alabama

Property Description: Township 18 South,
Range 5 East (Sections 1, 2, 11, and 12),
and Range 6 East (Sections 6 and 7),
Huntsville Meridian

Installation Coordinates: 33°29'15" N
86°03'00" W

Support Facility: Anniston Army Depot

Size: 2,836 acres
(1,711 acre buffer zone, 1,125 acre storage area)

Mission: The Annex was originally part of an ordnance assembly and storage operation during World War II known as the Coosa River Ordnance Plant. The Annex primarily consists of the 136 storage igloos remaining after the ordnance assembly portion of the property was excised in 1947.

Operations: Since 1982, the Annex has stored only inert parts (such as bomb fins, empty mortar shells, and empty wooden ammunition boxes) and no ammunition. The Alabama National Guard currently uses the Annex for materials handling training, using inert materials.

Environmental Contact: Ronald M. Grant
Chief, Environmental Management Division
Attn: SDSAN-DEL-EM
Anniston Army Depot
Anniston, Alabama 36201-5001
(205) 235-6350

Source: Adapted from Table 2-1, Weston, 1989.

TABLE 1-2

HISTORY OF THE COOSA RIVER STORAGE ANNEX

1941-1943	Land purchased from numerous private owners by the U.S. Government. Originally, the Coosa River Ordnance Plant was operated by the Brecon Loading Company which, beginning in 1941, received bagged powder by rail from the Alabama Army Ammunition Plant (AAAP) and loaded propelling charge containers.
1947	The southern portion of the Coosa River Ordnance Plant facility, which contained all ordnance assembly operations, was conveyed to Coosa Valley Development Corporation. Accountability for the Coosa River Storage Annex, the northern part of the facility which contained all of the igloo storage area, was transferred to the Anniston Army Depot (ANAD).
1973	The County of Talladega began operating a sanitary landfill in an area just inside the Annex's west boundary. The deed transferring this property from the U.S. Government to the County is dated 9 November 1976.
October 1982	Storage of explosives at the Annex was discontinued, with future storage restricted to inert parts.
July 1984	Historic Properties Report for the Anniston Army Depot and the Coosa River Storage Annex was completed by Building Technology Inc. for the Historic American Building Survey/Historic American Engineering Record, National Park Service, U.S. Department of the Interior, under an inter-agency agreement as part of the U.S. Army Materiel Development and Readiness Command (DARCOM) Historical / Archeological Survey.
October 1984	Archeological Overview and Management Plan for the Coosa River Storage Annex was completed by Woodward-Clyde Consultants for the National Park Service, U.S. Department of the Interior, under an inter-agency agreement as part of the U.S. Army Materiel Development and Readiness Command (DARCOM) Historical / Archeological Survey.
July 1985	The Alabama National Guard entered into an agreement to use the Annex as a materials handling training site.
December 1988	The Annex preliminary excessing action was submitted under Base Realignment and Closure Action.
September 1989	Interim Installation Assessment of the Annex was completed by the Environmental Photographic Interpretation Center (EPIC) for USATHAMA.
December 1989	Enhanced Preliminary Assessment of the Annex was completed by Roy F. Weston, Inc. for USATHAMA.
January 1990	Three USTs at the Annex were removed by Geraghty & Miller, Inc. for ANAD.

TABLE 1-2 (cont.)

June 1990	Development of Draft Final Technical Plan, Draft Final Sampling Plan, and Draft Final Health and Safety Plan for an Environmental Investigation of the Annex were completed by Dames & Moore for USATHAMA.
September 1990	Environmental Investigation of the Annex was tasked to Jacobs Engineering Group Inc. by USATHAMA.
February 1991	Alabama Department of Environmental Management (ADEM) approves Geraghty & Miller's Work Plan for [UST] Secondary Site Assessment.
July 1991	Secondary Site Assessment of a former UST (UST 90-5-20) at the Annex was completed by Geraghty & Miller, Inc. for ANAD.
November 1991	ADEM issues letter to ANAD in which it states "no further investigative or corrective actions will be required for this [UST] site at this time."

Source: Adapted from Table 2-2, Weston, 1989.

TABLE 1-3

IGLOOS AND LOADING RAMPS PRESENT AT THE
COOSA RIVER STORAGE ANNEX

	01	02	03	04	05	06	07	08	09	10	11	12	13	Row Count	Annex Count	
IGLOOS	15	1501	1502	1503	1504	1505	1506	1507	1508	1509				9	9	
	16	1601	1602	1603	1604	1605	1606	1607		1609				8	17	
	17	1701	1702	1703	1704	1705	1706	1707	1708	1709	1710			10	27	
	18				1804	1805	1806	1807	1808	1809					6	33
	19	1901	1902	1903	1904		1906	1907	1908	1909	1910				9	42
	20	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010				10	52
	21	2101	2102	2103	2104	2105			2108						6	58
	22	2201	2202	2203	2204	2205	2206								6	64
	23	2301	2302	2303	2304	2305		2307	2308		2310				8	72
	24		2402	2403	2404	2405	2406	2407							6	78
	25	2501	2502	2503											3	81
	26		2602	2603	2604	2605	2606			2608	2609		2612	2613	10	91
	27	2701	2702	2703	2704	2705		2707	2708		2710	2711			9	100
	28	2801	2802	2803	2804		2806	2807	2808	2809	2810				9	109
	29	2901	2902	2903	2904	2905	2906		2908	2909	2910				9	118
	30	3001	3002	3003		3005	3006	3007	3008	3009	3010	3011			10	128
	31	3101	3102				3106	3107	3108		3110				6	134
	33	3301	3302												2	136
	LOADING RAMPS				3404	3405	3406	3407	3408							
	34														5	5

NOTES:

Row numbering begins at 15; there is no row 32.
Blanks denote non-existence of the structure.

TABLE 1-4

**ROAD NOMENCLATURE
COOSA RIVER STORAGE ANNEX**

AS USED IN PREVIOUS REPORTS (1)	AS USED IN THIS REPORT (2)	DESCRIPTION / MAIN FEATURES
R1	M-25	Road down row of Igloos 3301 & 3302.
R1	P-3	Western fenceline perimeter patrol road; GD-1.
R2	M-3	Road down row of Igloos 1501 - 1509; GD-2.
R3	M-4	Road down row of Igloos 1601 - 1609; GD-3, GD-4, GD-5.
R4	M-5	Road down row of Igloos 1701 - 1710; GD-6, GD-8, GD-9; Pond 1.
R5	M-6	Road down row of Igloos 1804 - 1809; Loading Ramp 3408; GD-9.
R6	M-7	Road down row of Igloos 1901 - 1910.
R7	M-8	Road down row of Igloos 2001 - 2010; Loading Ramp 3407; GD-10.
R8	M-9	Road down row of Igloos 2101 - 2108; GD-10, GD-11; Pond 2.
R9	M-10	Road down row of Igloos 2201 - 2206; Loading Ramp 3406.

TABLE 1-4

**ROAD NOMENCLATURE
COOSA RIVER STORAGE ANNEX**

AS USED IN PREVIOUS REPORTS (1)	AS USED IN THIS REPORT (2)	DESCRIPTION / MAIN FEATURES
R10	M-11	Road down row of Igloos 2301 - 2310.
R11	M-2	Road down row of Igloos 2401 - 2407; GD-12, GD-13.
R12	M-21	Road down row of Igloos 2501 - 2503.
R13	M-12	Discontinuous road down row of Igloos 2602 - 2613; GD-14, GD-16, GD-17, GD-19.
R14	M-13	Road down row of Igloos 2701 - 2710.
R15	M-2	Diagonal road from N entry gate; GD-14.
R16	M-14	Road down row of Igloos 2801 - 2810.
R17	M-15	Road down row of Igloos 2901 - 2910; GD-20; Pond 3.
R18	M-16	Road down row of Igloos 3001 - 3011; GD-21.
R19	M-20	N-S road along row of Igloos 3106 - 3109; continues as E-W bisector road.
R19	M-17	South loop road along row of Igloos 3101 & 3102.
R19	B-7	Southern extension of M-17; Pond 4.

TABLE 1-4

ROAD NOMENCLATURE
COOSA RIVER STORAGE ANNEX

AS USED IN PREVIOUS REPORTS (1)	AS USED IN THIS REPORT (2)	DESCRIPTION / MAIN FEATURES
R20	P-3	Eastern fenceline perimeter patrol road.
--	M-1	Southern E-W road; GD-7.
--	M-24	Loading Ramps 3404 & 3405.
Various	P-3	N, W, & E fenceline perimeter patrol road.

NOTES:

- (1) Previous reports are Weston, 1989, and Dames & Moore, 1990.
 - (2) Based upon road nomenclature used in War Department, 1942.
- GD = Ground disturbance.
-- = No identifier used.

TABLE 1-5
NITROAROMATICS AND METALS
POTENTIALLY PRESENT AT COOSA RIVER STORAGE ANNEX
DUE TO HANDLING OF
EXPLOSIVES AND PROPELLANTS FROM THE
ALABAMA ARMY AMMUNITION PLANT

Nitroaromatics / Explosives

2,4-Dinitrotoluene (2,4-DNT)
2,6-Dinitrotoluene (2,6-DNT)
2,4,6-Trinitrotoluene (2,4,6-TNT)
Tetryl
Nitrocellulose (NC)

Metals Potentially Present in Propellants

Lead (Pb)^a
Mercury (Hg)^b

^a Associated with lead azide.

^b Associated with mercury fulminate.

Source: Adapted from Table A-7, Dames & Moore, 1990.

TABLE 1-6

SUMMARY OF LOADING RAMPS
COOSA RIVER STORAGE ANNEX

LOADING RAMP	LOCATION	DISTINGUISHING FEATURES
3404	On M-24, S of 3405, and W of Igloo 2602	Metal-roofed concrete platform
3405	On M-24, N of 3404, and W of Igloo 2605	Metal-roofed concrete platform; metal structure of unknown function
3406	On NW side of M-10, W of Igloo 2308, near intersection with M-11	Unroofed concrete platform
3407	On E side of M-7, N of Igloo 1904	Unroofed concrete platform
3408	On E side of M-6, S of Igloo 1804	Unroofed concrete platform; debris pile to N

TABLE 1-7

SUMMARY OF GROUND DISTURBANCES
COOSA RIVER STORAGE ANNEX

ID NUMBER	LOCATION	APPROXIMATE DIMENSIONS		DISTINGUISHING FEATURES	POSSIBLE USE/ CAUSE OF DISTURBANCE
		N-S x E-W			
GD-1	W of W fence line, 150 ft W of P-3, midway between NW fence corner and culvert 300 ft S of fence corner	Circular diameter = 50 ft		Circular berm, may contain water, hummocky ground in area	Unknown
GD-2	25 ft W of M-3, opposite Igloo 1501	Rectangular 200 x 150 ft		North part of area is old turnabout NW of Igloo, south part of area is W of Igloo and now forested	Grading
GD-3	150 ft W of M-5, 75 ft N of Igloo 1609, 75 ft W of Pond 1	Rectangular 75 x 75 ft		Well vegetated, berm on N side of area	Borrow area
GD-4	50 ft W of M-4, 100 ft ENE of Igloo 1506	Rectangular 150 x 100 ft		Slight lack of vegetation	Unknown
GD-5	30 ft W of M-5, 120 ft NW of Igloo 1701	Rectangular 150 x 100 ft		Lack of vegetation, some bare earth	Borrow area
GD-6	30 ft W of M-5, 120 ft NW of Igloo 1701	Crescent shaped 150 x 50 ft		Unknown	Unknown
GD-7	S of S perimeter road M-1, bounded by M-6 on E and M-3 on W	Rectangular 300 x 600 ft		Large grassy area, no trees	Grading
GD-8	E of M-5, 50 ft N of Igloo 1707, on slope N of ditch	Rectangular 50 x 100 ft		Sloped, little vegetation	Unknown

TABLE 1-7
 SUMMARY OF GROUND DISTURBANCES
 COOSA RIVER STORAGE ANNEX

ID NUMBER	LOCATION	APPROXIMATE DIMENSIONS N-S x E-W	DISTINGUISHING FEATURES	POSSIBLE USE/ CAUSE OF DISTURBANCE
GD-9	Midway between M-5 & M-6 and Igloos 1704 & 1705	Rectangular 200 x 100 ft	Few trees, some bare earth	Borrow area
GD-10	100 ft W of M-9, 80 ft SE of Igloo 2005	Rectangular 200 x 80 ft	Berms, some exposed earth	Borrow area
GD-11	120 ft E of M-9, midway between Igloos 2103 & 2104	Rectangular 120 x 80 ft	Small berms	Borrow area
GD-12	100 ft W of M-2, dirt road off of W side of M-2 opposite Igloo 2407 leads to area	Square 250 x 250 ft	Little evidence, small berms In SE corner, low-lying marsh S of area	Grading
GD-13	120 ft E of M-2, 200 ft SE of Igloo 2405	Circular diameter = 150 ft	Areas where old dirt roads cross	Grading
GD-14	300 ft SE of M-2, 750 ft W of Igloo 2609	Circular diameter = 200 ft	Exposed earth, little vegetation	Borrow area
GD-15	W of M-24, 500 ft SW of Loading Ramp 3405	Circular diameter = 150 ft	Exposed earth, gully to dirt road	Borrow area
GD-16	W of M-12, 50 ft SW of SW corner of Igloo 2610	Rectangular 40 x 80 ft	Unknown, NOT area west of Igloo 2610	Grading
GD-17	W of M-12, 100 ft N of Igloo 2609	Rectangular 75 x 150 ft	Exposed earth	Borrow area, previously mounded material

TABLE 1-7
 SUMMARY OF GROUND DISTURBANCES
 COOSA RIVER STORAGE ANNEX

ID NUMBER	LOCATION	APPROXIMATE DIMENSIONS		DISTINGUISHING FEATURES	POSSIBLE USE/ CAUSE OF DISTURBANCE
		N-S x E-W			
GD-18	E of M-24, approximately 150 ft NE of Loading Ramp 3405, N of dirt circleback road E of ramp	Rectangular 100 x 200 ft		Lack of trees, berm along western border	Loading ramp activity
GD-19	25 ft E of M-12, opposite Igloo 2605	Rectangular 100 x 20 ft		Unknown	Borrow area
GD-20	E of M-15, and S of N fenceline perimeter road P-3	Circular diameter = 150 ft		Drainage ditch to south, lack of vegetation	Borrow area
GD-21	W of M-16, S of Igloo 3003, on elevated ground	Circular diameter = 100 ft		Lack of trees, cut tree stumps	Grading

Notes:

Directional information: N = north, S = south, E = east, W = west.
 Measurements provided based on estimates taken during Technical Plan's site reconnaissance.
 Source: Adapted from Table A-5, Dames & Moore, 1990.

TABLE 1-8

SUMMARY OF EXCAVATED PONDS
COOSA RIVER STORAGE ANNEX

POND	LOCATION	APPROXIMATE DIMENSIONS N-S x E-W x Depth	DISTINGUISHING FEATURES	WETLANDS CLASSIFICATION
Pond 1	75 ft W of M-5, W of Igloo 1710	200 x 150 x 5 ft	Obvious grading	POWHx
Pond 2	120 ft E of M-9, SE of Igloo 2108	150 x 150 x 5 ft	Obvious grading	POWHx
Pond 3	75 ft E of M-15, 500 ft SE of Igloo 2908	100 x 100 x 3 ft	Obvious grading, seeps on NE slope, ditch to S of pond	POWHx
Pond 4	200 ft W of S end of B-7	Unknown	Area flooded by rain due to beaver dam	POWHh

Notes:

Directional information: N = north, S = south, E = east, W = west.
Measurements provided based on estimates taken during Technical Plan site reconnaissance.
See Table 2-2 for explanation of wetlands classifications.
Source: Adapted from Table A-6, Dames & Moore, 1990.

2.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

The following sections describe the archaeological resources, climatology, topography, surface water hydrology, wetlands, geology/hydrogeology, sensitive environments, ecological profile, surrounding land use and demography, and potential exposure pathways of the Coosa River Storage Annex.

2.1 ARCHAEOLOGICAL RESOURCES

No prehistoric or historical cultural resources are recorded on the facility at present. The potential for locating unrecorded prehistoric cultural resources on the Annex is also considered to be low. No buildings predating the construction of the Annex are known to exist on the property. Two historic cemeteries exist on the property. Although historic cemeteries often contain significant cultural information, the U.S. Department of the Interior regulations at 36 CFR 60.6 exclude them from eligibility for the National Register of Historic Places [Dye, 1984].

2.2 CLIMATOLOGY

The Annex and surrounding area are located in a temperate and humid climate. Extremes of temperature are uncommon and generally of short duration. The local climate is influenced by weather patterns and disturbances associated with the continent and the Gulf of Mexico [Pierce, 1955]. Summer air originates mainly in the Gulf of Mexico and the Atlantic Ocean. Severe disturbances occasionally produce high winds, thunderstorms, hail, and tornados. In the winter, mild moist maritime air alternates with cool, dry continental air, bringing many mild, wet days [Weston, 1989].

Average annual precipitation in the Annex area is 54.52 inches. Precipitation is fairly evenly distributed throughout the year. The largest amounts of precipitation occur in March (average monthly rainfall of 6.62 inches), July (5.39 inches), January (5.23 inches) and April (5.00 inches). Continental air-mass disturbances dominate the local weather patterns for March, while oceanic effects influence weather patterns for July. Rainfall in July is generally of shorter duration and higher intensity. The lowest amount of precipitation occurs in October, with an average monthly rainfall of 2.64 inches.

Summer rainfall occurs mainly from showers and thundershowers. The maximum amount of rain recorded in any 24-hour period was 8.84 inches during July 1916. The minimum monthly precipitation was during September 1955, when only a trace was recorded. Snowfall does

occur with an average of 1.4 inches per year. Snowfall may not occur for a 2- to 3-year period [Weston, 1989].

The annual average temperature for Talladega, Alabama, is 63.4°F. Temperatures vary from season to season. July is the warmest month, with a mean monthly temperature of 80.2°F, and a normal daily minimum temperature of 69.8°F. Summers are hot with persistent high humidity. January is the coldest month with a normal monthly temperature of 42.9°F, a daily maximum of 52.7°F, and a daily minimum of 33°F. December is the next coldest month, with a mean monthly temperature of 46.5°F [Weston, 1989].

The Annex is far enough inland from the Gulf of Mexico that any destructive tropical storms (hurricanes) will cause minor damage. Some damage can occur from high winds and heavy rain. Tornadoes do occur in Alabama. Nearly all tornadoes occur from November through early May. Some thunderstorms reach a severe level and are accompanied by high winds, heavy rain, and hail [Weston, 1989]. On the average, thunderstorms occur 58 days per year, with the majority occurring during May through August [NOAA, 1988].

Winds at the Annex occur predominantly from the northeast, though winds from the north and south are not uncommon. Figure 2-1 is a wind rose of 1988 wind conditions for the Birmingham, Alabama, area. Northeast winds occur most frequently, with a secondary maximum of north winds [Weston, 1989].

2.3 TOPOGRAPHY

Elevations at the Annex range from approximately 1,000 feet above mean sea level (msl) to 540 feet above msl. The maximum elevation at the Annex occurs in the northwest portion of the site. The minimum elevations occur where an unnamed tributary of Kelly Creek crosses the eastern property boundary. Relief is greater in the northern and western ends of the Annex. The developed area of the Annex has little relief and slopes gently toward the east-southeast. Figure 2-2 illustrates the topography of the site.

2.4 SURFACE WATER HYDROLOGY

Talladega County is drained by the Coosa River, which flows in a southerly direction 10 miles to the west of the Annex. Figure 2-3 illustrates the surface water drainage at the Annex. Table 2-1 summarizes the surface water pathway exposure elements.

Surface water drainage at the Annex follows one of two pathways to reach the Coosa River approximately 15 miles downstream.

Drainage from the mountainous area in the northern and western portions of the Annex flows northwesterly in two small perennial streams approximately four miles before joining Choccolocco Creek, a Coosa River tributary. From this confluence, Choccolocco Creek flows for approximately 10.4 miles to the point where it enters Logan Martin Lake, which is part of the Coosa River. Stream flow and usage information for Choccolocco Creek are presented below.

Three small intermittent streams, which form the headwaters of Kelly Creek, drain the southern and eastern portions of the Annex [Dye, 1984]. These streams flow in drainage ditches from west to east. Kelly Creek flows northeasterly approximately 2.4 miles before joining Cheaha Creek. According to the best usage classifications established by the State of Alabama, these tributaries and Kelly Creek itself are classed for agricultural and industrial water supply. Stream flow in Kelly Creek is less than three (3) cubic feet per second (cfs), based on the median annual 7-day low flow with a recurrence interval of 2 years (7-day Q₂) [Harkins, 1972].

Cheaha Creek flows to the northwest for approximately three (3) miles where it joins Choccolocco Creek. According to the best usage classifications established by the State of Alabama, Cheaha Creek is classed for swimming and other whole body water-contact sports (class code S), as well as for fishing, propagation of fish, aquatic life and wildlife, and any other usage except as a source of water supply for drinking or food-processing purposes. Stream flow in Cheaha Creek increases to 19 cfs near its confluence with Choccolocco Creek, based on the 7-day Q₂ flow [Harkins, 1972].

According to the best usage classifications established by the State of Alabama, Choccolocco Creek is classed for fishing, propagation of fish, aquatic life and wildlife, and any other usage except for swimming and other whole body water-contact sports or as a source of water supply for drinking or food-processing purposes (class code F&W). Stream flow in Choccolocco Creek near to the location where Choccolocco Creek joins the Coosa River increases to 170 cfs, based on the 7-day Q₂ flow; in contrast, the measured average (Q_{avg}) flow at this point is 695 cfs [Harkins, 1972]. Choccolocco Creek flows for approximately 7.4 miles from its confluence with Cheaha Creek to Logan Martin Lake, which is part of the Coosa River.

According to the best usage classifications established by the State of Alabama, Logan Martin Lake is classed for swimming and other whole body water-contact sports, as well as for fishing, propagation of fish, aquatic life and wildlife, and any other usage except as a source of water supply for drinking or food-processing purposes (class code S). Flow in the Logan Martin

Lake segment of the Coosa River downstream of the confluence of Choccolocco Creek increases to 2,800 cfs, based on the 7-day Q_2 flow; in contrast, the measured average (Q_{avg}) flow at this point is 12,600 cfs [Harkins, 1972].

Along the 15 mile downstream distance limit from the site to the Coosa River, no drinking water intakes are known to exist that serve residents of either Talladega County [Harvey, 1991; Pratt, 1991; Martin, 1991; and Walton, 1991] or Calhoun County [Hefner, 1991].

Along the lower three-quarters of this 15-mile stretch (from the confluence of Kelly and Cheaha Creeks to the Coosa River), the Alabama Department of Conservation and Natural Resources Division of Game and Fish recognizes the existence of fisheries. This corresponds to the best usage classifications of fish and wildlife established by the State of Alabama for these water bodies. This does not preclude the possibility that some form of aquatic organism is also occasionally taken from Kelly Creek for human consumption [Floyd, 1991].

Based on Flood Insurance Rate Maps of Talladega County [FEMA, 1980], areas in the southeastern portion of the Annex may be impacted by a 100-year flood event. These areas are outlined on Figure 2-3.

Small ponds are common in Talladega County. Four ponds are present at the Annex, as shown on Figure 2-3. Three of these ponds appear to be manmade as the result of excavations. The fourth pond, located in the southeast corner of the Annex, appears to be associated with a low-lying area where surface water accumulates. No evidence of excavation was observed at this location during the Technical Plan's site reconnaissance effort. This pond was observed, during the field investigation sampling effort of this EI, to be the result of a beaver dam.

2.5 WETLANDS

A representative of the U.S. Fish and Wildlife Service inspected the Annex in 1989 and reported that no significant wetlands were present on the property [Weston, 1989]. Official identification and delineation of wetlands in Talladega County has not yet been conducted [Friday, 1991]. While visual evaluation of the USGS 7.5-minute quadrangle topographic maps of the area does not indicate the presence of symbols used to identify wetlands [USGS, 1947], a review of the National Wetlands Inventory map prepared by the U.S. Fish and Wildlife Service identifies several different types of wetlands within the property boundaries. It should be noted that this map was created by using high-altitude aerial photography in accordance with "Classification of Wetlands and Deepwater Habitats of the United States" [FWS, 1979].

This method may not be as accurate as a detailed site inspection. Figure 2-4 shows the locations of the wetlands, and Table 2-2 lists the types of wetlands identified.

As shown in Table 1-8, of the five different types of wetlands identified, the four ponds identified by the Enhanced PA were all classified as Palustrine system, open water class, permanently flooded (i.e., POWH) [Weston, 1989].

2.6 GEOLOGY/HYDROGEOLOGY

The Annex is located in the Ridge and Valley physiographic province of the Appalachian Highlands, within the regional structural feature known as the Coosa Valley. The geologic units in Talladega County in the vicinity of the Annex are grouped into the Foreland Fold and Thrust belt, which consists of sedimentary rocks [Moser, 1988]. The Annex is underlain by four separate lithologic units, as illustrated on Figure 2-5. These units are composed of quartzite, dolomite, shale, and limestone, and follow the northeast/southwest regional structural trend [Causey, 1965].

From west to east across the site, these lithologies become younger in age. The quartzite of the Cambrian-age Chilhowee Group is the most resistant lithology and underlies the ridge located in the western and northern portions of the Annex. Immediately to the east of the quartzite is the Shady Dolomite. This 500-ft thick fine- to medium-grained crystalline dolomite trends along the principal northeast/southwest diagonal through the Annex. The southeastern section of the Annex is underlain, in general, by shales of the Rome and lower Conasauga Formations, with a combined thickness of 1,400 feet. Finally, the extreme southeastern section of the Annex is underlain by limestone of the upper Conasauga Formation, which has a thickness of over 2,000 ft.

Two primary soil types are present at the Annex -- the Allen Series and the Locust Series [Cotton, 1974]. The distribution of these soils is illustrated on Figure 2-6, and descriptions are provided below:

- o Allen Series -- Deep, well-drained soils formed in colluvium or alluvium derived from weathered sandstone and shale. These soils are composed of fine, sandy loam at the surface, with moderate permeabilities and medium infiltration rates. They are found predominantly in the northwestern and central portion of the Annex and appear to coincide with the underlying quartzite and dolomite bedrock. The Allen association is the predominant soil type at the Annex.

- o Locust Series -- Deep, moderately well-drained cherty soils derived from weathered sandstone, shale, and cherty limestone. These soils have a moderate permeability. The surficial 4-inch thick silt loam is underlain by a clay loam, which in turn is underlain by a hard, brittle, clay loam typically over 40 inches thick. These soils are generally located in the southeastern portion of the Annex, which is underlain by shaley bedrock.

Limited site-specific data are available pertaining to the groundwater at the Annex. Ordovician and Cambrian rock units underlie the entire Annex. The great thickness and nonporous character of these rock units form a poor aquifer except where fractures permit groundwater movement [Dye, 1984]. In general, groundwater in the vicinity of the Annex is found at depths ranging from 10 ft to 35 ft below ground surface [Moser, 1988]. Groundwater flow likely follows topography. The inferred groundwater flow direction at the Annex is presented on Figure 2-7. Given the variability of the underlying geology, groundwater may flow preferentially through fractures, cavities, and other structural features.

Shallow groundwater is the primary source of potable water in Talladega County [Weston, 1989]. Groundwater in the vicinity of the Annex is found at depths ranging from zero feet where springs exist to approximately 80 feet below ground surface. Three artesian springs are located within four miles of the Annex. Figure 2-8 illustrates the locations of the wells and springs identified within a four-mile radius of the Annex, while Table 2-3 provides pertinent information on those wells and springs.

There are no registered public water supply wells within one mile of the Annex. Brecon Spring, which is owned by the City of Talladega but not used for water supply, is located approximately 1,400 ft south of the Annex. There are no other springs on file with ADEM within a one-mile radius of the site. The City of Talladega obtains most of its water supply from wells, but supplemental water is obtained from Talladega Creek during periods of peak demand [Moser, 1988]. The City of Talladega provides potable water supply to all areas located within a one-mile radius of the Annex, and is the water source for the bathhouse at the Annex.

2.7 SENSITIVE ENVIRONMENTS

The Enhanced PA [Weston, 1989] reports that no endangered species are believed to exist at the Annex; however, it should be noted that a detailed evaluation of the species present at the Annex has not been conducted, neither as part of the Enhanced PA nor as part of this EI.

An initial assessment by the U.S. Fish and Wildlife Service in 1989 tentatively determined that no environmentally significant wetlands and no endangered species were likely to be present, but that endangered species may be present, especially if any cold water springs exist on the property [Weston, 1989]. To make a conclusive determination, a more in-depth endangered species field survey would be necessary. Such a survey was beyond the scope of this EI. Table 2-4 lists the endangered and rare species of plants and animals known to be present within Talladega County [Mount, 1986].

The upland habitat of the Annex supports a variety of animal life. Beaver, rabbits, white-tailed deer, turkeys, and a variety of birds are known to be present at the site.

Beyond the Annex boundary, Choccolocco Creek represents the only potentially sensitive environment identified along the 15-mile downstream distance limit to the Coosa River. Choccolocco Creek may represent part of the range of a Federally-listed endangered species, the Alabama live-bearing snail, *Tulotoma magnifica*. In addition, several species of freshwater mussels with varying conservation statuses may also occur in Choccolocco Creek. Although sampling efforts have not confirmed the occurrence of these organisms, the type and structure of habitats present in Choccolocco Creek indicate such a potential [Bailey, 1991].

2.8 ECOLOGICAL PROFILE

The ecological profile of the Annex and surrounding area was developed from existing documents, empirical observations made during a site reconnaissance visit during this EI, contemporary information obtained from local sources and experts, and general regional and historical literature sources. It should be noted that comprehensive biological inventories consisting of sampling and detailed taxonomic studies were not conducted at the Annex since they are beyond the scope of this EI. With respect to the ecological assessment, the Annex proper is considered the igloo storage area contained within the boundary defined by the innermost security fence. A secondary unsecured fenceline defines the overall federal property boundary. Due to the assumed absence of contamination, this buffer zone between the igloo storage area and private land is not considered in the ecological assessment, except in a peripheral context.

2.8.1 ENVIRONMENTAL SETTING

Regionally, the Annex lies in the transition zone between the Appalachian Ridge and Valley Province and the Piedmont Province [USATHAMA, 1989]. The site itself is situated on a bench immediately east of Bald Mountain and immediately south of Gents Mountain. A

conspicuous surface feature of the Annex is the grid-like system of roads and igloo structures that covers the majority of the site. Other surface features include several low-lying marshy areas, several man-made impoundments, a beaver pond, and a natural drainage system of intermittent systems. Water regimes of the surface water impoundments, the marshy areas, and the intermittent streams are influenced and determined mainly by precipitation patterns and runoff characteristics. According to the Natural Resource Manager at Anniston Army Depot, no springs are known to contribute to surface water flow at the Annex.

Vegetative land cover at the site is typical of a disturbed area within the Appalachian/Piedmont transition zone, consisting mainly of subclimax mixed woodlands (interspersed pines and deciduous hardwoods), and patchy grassland areas. The major vegetative associations at the Annex currently include:

- o mixed evergreen/deciduous multi-canopy forest (consisting of loblolly, long-leaf, and short-leaf pines, and various oaks and hickory),
- o "old field" successional areas dominated by grasses and invasive weeds, and
- o forested wetland communities in the low-lying areas.

Vegetation resources at the Annex are managed by the Natural Resource Manager at the nearby Anniston Army Depot (ANAD), according to guidelines provided in the Natural Resource Management Plan for both the Depot and the Annex. Primary forms of vegetation management at the Annex include:

- o controlled burning of forested areas (the most recent controlled burn of the grounds occurred in the first week of March 1992; previously, the majority of the site was burned approximately five years ago);
- o application of herbicides along the innermost security fence;
- o application of herbicides and physical removal of vegetation in front of igloos; and
- o mowing of grassy areas.

2.8.2 BIOTIC POPULATIONS AND COMMUNITIES

The main floral and faunal communities at and around the site can be characterized as the biotic components of three ecosystems: terrestrial, semi-aquatic (marshy areas and beaver

pond edge), and aquatic. The boundaries between these ecosystems are often indistinct. For example, depending on the amount of water entering the overall system (i.e., precipitation), a portion of the marshy area can be dry and terrestrial in nature one week, and fully flooded and submerged, and hence aquatic, the next week. Nonetheless, the biotic elements of the ecosystems at and near the Annex continually interact among themselves and with the abiotic compartments (i.e., the environmental media represented by soil, sediment, and water). The potential interactions between area biota and contaminated environmental media detected at the Annex, and potential effects of such interactions, represent the primary focus of the ecological assessment. Although mentioned to varying degrees, influences and interactions which may be linked to other environmental stresses at and near the Annex do not factor into this assessment.

The biotic elements at and near the Annex were identified through a variety of means. Identification of dominant vegetation types and faunal populations is based on existing documents and local expertise, supplemented by empirical observation. This information served to identify conspicuous organisms known to either utilize the site or occur at or in the vicinity of the site.

2.8.2.1 Flora

In general, vegetation at the Annex is determined by environmental conditions. Examples of such environmental conditions include soil conditions, water availability, and degree of disturbance. The main floral elements at the site are provided in Section 2.8.1. The majority of the Annex is typified by terrestrial upland habitat, dominated by a mixture of evergreen and deciduous hardwood trees. Aquatic and semi-aquatic flora at the site is generally restricted to the surface water impoundments (i.e., the four excavation ponds and the beaver pond).

2.8.2.2 Fauna

Faunal elements either inhabiting or utilizing the Annex have been identified in previously published reports, as well as by persons familiar with the area [Brooks, 1992; Burns, 1992; and Haynes, 1992]. Faunal elements identified through these sources represent the most conspicuous species, such as white-tail deer, wild turkey, rabbits, squirrels, raccoons, opossum, quail, crows, and hawks. While such conspicuous wildlife can occupy important positions within the ecosystems, inconspicuous organisms are generally more abundant, and tend to occupy a wider range of niches. For example, organisms representing the various invertebrate phyla are noticeably absent from most lists of species known or assumed to occur at the site.

2.8.3 SENSITIVE OR IMPORTANT ECOLOGICAL ELEMENTS

One of the main objectives of this ecological assessment is to identify specific components of the biota which may be at particular risk of exposure to contaminants at the site. While each individual organism of the biota either inhabiting or utilizing the Annex can be considered a receptor with the potential for exposure, some populations or communities may deserve special attention, due to their uniqueness, sensitivity, trophic position, or importance.

2.8.3.1 Rare or Unique Populations, Communities, and Associations

Rare or unique populations, communities, and associations are those with limited range and representation. Rare, unique, or natural elements are generally not afforded any degree of legal protection [U.S. EPA, 1989a]; however, they are typically afforded varying degrees of consideration under various assessment scenarios. For example, sensitive environments constitute an evaluation factor within the U.S. EPA's Site Assessment process. Such sensitive environments include critical habitat for threatened or endangered species, and wetlands. No rare or unique plant populations, communities, or associations were observed or are known to be present at the Annex.

2.8.3.2 Sensitive Species

Sensitive species are those listed on State or Federal lists as being threatened or endangered. Each individual of a sensitive species is considered important to the survival of the species [U.S. EPA, 1989b], and is therefore afforded a degree of legal protection. Appendix A provides an overview of threatened or endangered species known or suspected to occur in the general area. As indicated previously, no individuals of any of these species are known to occur at or utilize the Annex. It should be noted that the majority of listed floral and faunal species (as of 20 August 1991) are inconspicuous species, representing rarely occurring plants, aquatic invertebrates, and aquatic and semi-aquatic vertebrates. The potential exists for species such as these to go undetected in the absence of exhaustive biological surveys and inventories.

2.8.3.3 Keystone Organisms

A keystone organism is one that plays a critical role in the energetics of an ecosystem. Examples of a critical role include trophic position (e.g., an important food item, or an

influential consumer), and structural/functional importance (e.g., critical habitat component). The concept of keystone organisms can also be extended to include guilds or communities, in situations where a guild or community occupies a critical position in the functioning of a system. None of the biotic elements occurring at and near the Annex are suspected of occupying a keystone position.

2.8.3.4 Vector Organisms

The Superfund Exposure Assessment Manual (SEAM) defines vector organisms as biotic populations that potentially serve as pathways for human exposure to hazardous materials [U.S. EPA, 1988]. Fish and game species that may be caught or hunted, and ultimately consumed by humans are specifically cited as vector organisms.

A wide variety of hunting activities, both sanctioned and illegal, take place at the Annex. Game species occurring in the vicinity of the site can be classified as either resident or migrant species. Resident species are those that complete their life cycle in the immediate area. Common resident game species include white-tailed deer, wild turkey, eastern cottontail rabbit, bobwhite quail, mourning dove, and raccoon. Migrant, or transient species either pass through the area during seasonal migration, or spend part of the year or part of their life cycle in the area. In the latter case, the area typically either represents one terminus of a migration range, or an edge of an occurrence range. Common migrant or transient game species include various taxa of ducks and geese.

Sport fish, which are the most common vector organisms typically associated with aquatic environments, are not known to occur in the on-site tributaries to Kelly Creek, nor in the on-site impoundments. The on-site surface water bodies appear to be incapable of supporting piscine populations, due to physical restraints, such as shallow depth, low or erratic flow, etc. Although other aquatic or semi-aquatic organisms may also serve as vector organisms, their presence on-site was not determined. The on-site surface water bodies are not known to support populations of herpetofauna (reptiles and amphibians) that may serve as vector organisms, nor are they known to support populations of crayfish that may represent potential human exposure pathways.

2.8.4 OTHER POTENTIAL INFLUENCES

The ecology of the Annex can be subject to a variety of influences other than those already mentioned. These influences can be classified as either anthropogenic or environmental in nature. The following ecological influences are associated with the current land use scenario.

2.8.4.1 Anthropogenic

Certain external influences on the ecology of an area can be directly attributable to human activity. Aside from the previously mentioned disturbances (e.g., controlled burning of the forest, and application of herbicides), the Annex may be subject to a variety of continual or periodic human impacts that may influence the ecology at and around the site. Uncontrolled burning attributable to a forest fire would have additional impact. Various industrial or commercial activities or endeavors in the vicinity of the Annex may result in the introduction of a wide range of chemical compounds to the environmental media at the site. Examples of potential inputs include:

- o dry fallout/deposition from local air emission sources, and
- o migration of agricultural chemicals via airborne drift, surface runoff, or infiltration.

Various recreational activities can also disrupt or otherwise affect the on-site ecology. The direct and obvious impacts associated with consumptive uses such as hunting and trapping have already been addressed. Such direct impacts include the actual removal of individuals from the local populations of game species. Such removal can also have secondary or indirect effects, as well, such as: breeding activities and habitat usage patterns of non-target species can be disrupted; trophic dynamics can be disrupted; and materials can be introduced to the environment, such as lead shot. Although not an issue at the Annex, even non-consumptive uses such as bird-watching can disturb certain species which are sensitive to intrusion, thereby disrupting common activities such as nesting, breeding, and feeding.

2.8.4.2 Environmental

Uncontrollable environmental variables can also influence the ecology of the area. Climatic extremes such as drought, flooding, or hard winter freeze can alter or influence the on-site habitats and ecosystems. Seasonal changes, which tend to be fairly predictable, can also exert influences on the ecology. Seasonal dominance and availability of key biotic elements can determine occurrence of and utilization by wildlife.

2.9 SURROUNDING LAND USE AND DEMOGRAPHY

Land around the Annex is primarily forest and farmland with some light industrial activity. Lumber, pulpwood, livestock, and soybeans comprise the primary land uses [NOAA, 1988].

According to data compiled in the 1982 and 1987 Census of Agriculture, the proportion of Talladega County acreage in farmland has declined from 28.6% in 1978, to 26.6% in 1982 [Bureau of the Census, 1984], to 23.8% in 1987 [Bureau of the Census, 1989]. Of the total land in farms in 1987, 26.9% was used as harvested cropland, 40.3% was used as pasture land, and 29.3% was used as woodland. The main harvested crops in 1987 were soybeans for beans, 30.7% of the harvested cropland; corn for grain or seed, 7.3% of the harvested cropland; and wheat for grain, 3.5% of the harvested cropland [Bureau of the Census, 1989].

Areas to the south of the site are predominantly residential, though some small industrial activity is present. The manufacturing buildings of the former Brecon Loading Company, situated along the Annex's southern border, are occupied by various small industries, including the Palm Springs Knitting Mill [Weston, 1989].

Since 1973, Talladega County has operated a sanitary landfill, known as the Brecon Landfill, along the western border of the Annex, on property excecised by the U.S. Army in 1976. According to the Enhanced PA [Weston, 1989], the landfill has no remaining capacity, and in 1989 the County agreed to sell the landfill to Waste Away, Inc., which plans to close the existing unlined landfill and construct a new sanitary landfill that will comply with Resource Conservation and Recovery Act (RCRA) Subtitle D requirements.

During preparation of the Technical Plan documents, it was discovered that two Talladega County landfills are present in the vicinity of Talladega, and that the landfill located on the previously excecised Annex property was not correctly identified in the Enhanced PA. The landfill along the current western border of the Annex is permitted as the Brecon Landfill by ADEM, and the landfill Waste Away, Inc. proposes to develop is the Odena Landfill, located near Sylacauga, Alabama. The Brecon Landfill is still operating; during the Technical Plan's site reconnaissance, a small transfer station was observed and dumping activities were being conducted. However, the majority of the landfill appears to be covered with vegetation [Dames & Moore, 1990].

Data provided by the Bureau of Census indicate that Talladega County has an average population of approximately 100 persons per square mile [Bureau of the Census, 1991]. Over 40% of the population is less than 25 years of age. Table 2-5 lists the population distribution by age.

Population data for Talladega County from 1910 to 1990 and for the City of Talladega from 1930 to 1990 are presented in Table 2-6. Further, the percent change in population for each decennial interval of both categories is also presented. The overall trend observed for the population changes in both Talladega County and the City of Talladega has been one of increase as reflected in the value of overall percentage change for Talladega County (95.4% from 1910 to 1990) and the City of Talladega (139.3% from 1930 to 1990). Closer inspection of these data finds that growth over the last 30 years (1960 to 1990) has slowed considerably from the pace of the 30 years before that (1930 to 1960). In Talladega County, the population grew only 13.1% from 1960 to 1990, whereas it had grown 44.8% from 1930 to 1960. In the City of Talladega, which is the largest conurbation (population center) within one mile of the Annex boundaries, population growth has been nearly flat over the last 30 years (2.4%), in marked contrast to the explosive growth (133.6%) seen in the pre- and post-World War II period (1930 to 1960). Thus, expansion of residential land use in the vicinity of the Annex does not appear likely in the near future.

2.10 POTENTIAL EXPOSURE PATHWAYS

2.10.1 RADON GAS INHALATION

If radon is present within any of the buildings at the Annex, occupancy or other utilization of the buildings could subject the user population to exposure to radon and its decay products via inhalation. Because the igloos are constructed with only minor passive ventilation, there is the potential for radon gas to be present within the structures. However, the potential for radon gas to be a significant health risk appears to be minimal because the igloos are vented, are not occupied by personnel, and the geology in the area does not appear to be related to igneous rocks from which high natural radon levels occur [Dames & Moore, 1990].

2.10.2 DERMAL CONTACT AND DUST INHALATION

If spills or other releases have occurred in the igloos, it is possible that contaminants may have been transported through the drains to the soils outside the front of these structures, resulting in likely potential exposure routes of dermal contact with those soils or inhalation of dust from those soils. The concrete floors of the igloos are another potential exposure route, because residual contamination from spills may be present on the floors. No water services were available at the Annex, with the exception of buildings S-1 and the bathhouse, so the potential for the igloo floors to have been washed or rinsed out is unlikely. Because explosive materials contained within the igloos were not in liquid form, the most likely route of exposure is via dust inhalation and dermal contact with any residual contamination [Dames & Moore, 1990].

The ground disturbance areas appear to be related to construction activities. It is unlikely that burning or burial activities occurred in these areas. If those types of activities did occur, however, they may have contaminated the surrounding soils and may present a dermal contact hazard to wildlife in the area [Dames & Moore, 1990].

The nonfriable nature of the asbestos identified in the floor tile at building S-3 and in the siding of building S-1 indicates that the potential health risk associated with dust inhalation is minimal. However, the destruction of these buildings may necessitate special precautions, especially when removing siding, because the asbestos will likely become friable and pose a potential health risk to workers [Dames & Moore, 1990].

2.10.3 SURFACE WATER/SEDIMENT

The excavated ponds and the streams present at the Annex are two potential surface water/sediment exposure pathways. Although no burning or waste disposal activities are suspected to have occurred in the excavated ponds, those types of activities could result in contamination of both the surface water and sediment within these ponds [Dames & Moore, 1990].

Surface water runoff from waste disposal areas or any undocumented spills that may have occurred at the Annex may have an impact on the streams that run throughout the site. Although the potential for contaminants to be present in these streams is minimal due to dilution from precipitation, contamination from previous spills or releases may still be present in the stream sediments [Dames & Moore, 1990].

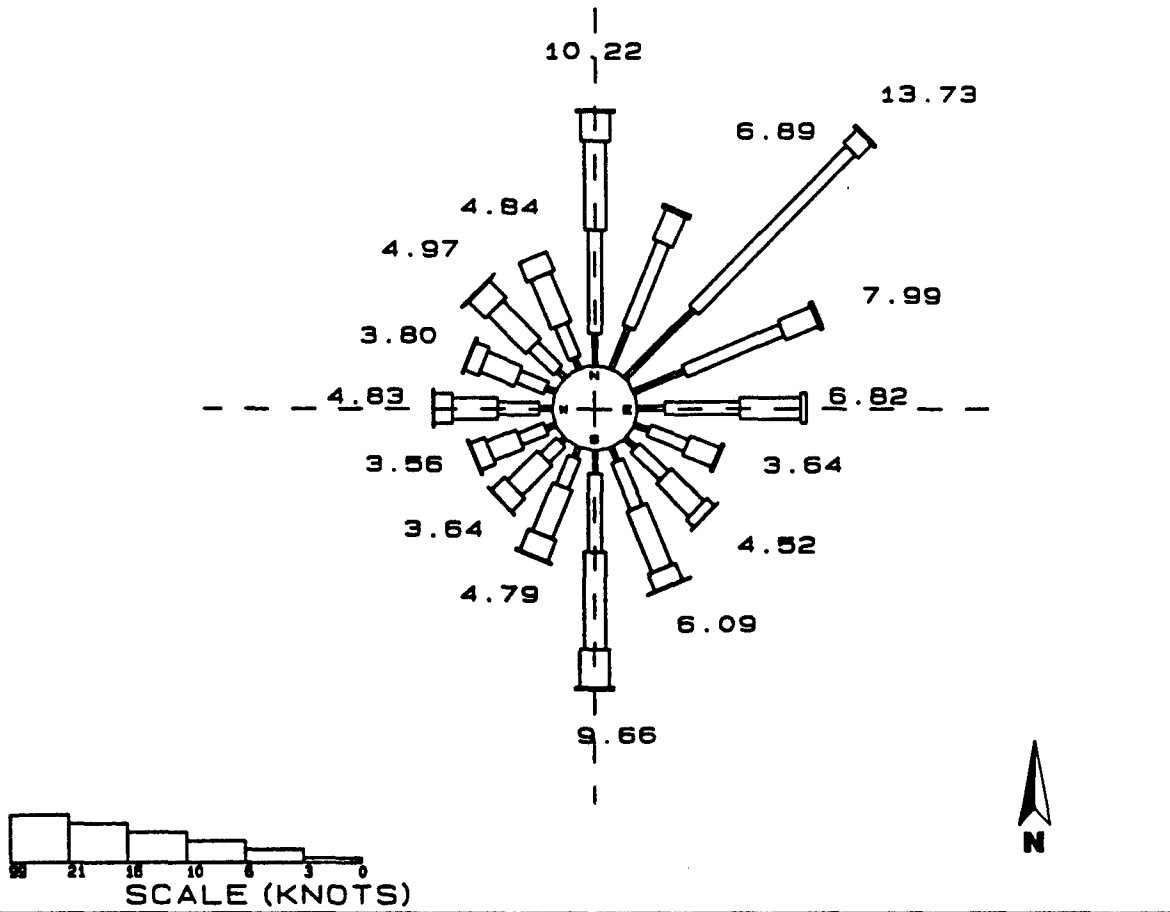
The streams that flow through the Annex feed into Kelly Creek. Any contaminants in the Annex streams may impact human health, because Kelly Creek is used for recreational fishing downstream from the Annex. Wildlife present at the Annex may also be impacted by contaminated surface water/sediment through direct contact and ingestion exposure routes [Dames & Moore, 1990].

2.10.4 GROUNDWATER

Groundwater is the exposure pathway of greatest potential concern at the Annex, because it is the major source of local drinking water. However, the Technical Plan determined that it is unlikely that activities conducted at the Annex could have impacted groundwater quality in the

area [Dames & Moore, 1990], and therefore investigation of groundwater was outside the scope of this EI.

BIRMINGHAM, ALABAMA
 YEAR: 1988
 CALMS INCLUDED



Source: Weston, 1989

	WIND SPEED (KNOTS)						PERCENT OCCURRENCE					
	0-3	3-6	6-9	9-12	12-15	>15	0-3	3-6	6-9	9-12	12-15	>15
N	1.28	4.16	3.86	1.16	0.06	0.00	0.86	3.13	3.63	1.66	0.10	0.00
NNE	1.80	3.64	1.28	0.16	0.00	0.00	0.47	1.27	2.08	0.92	0.06	0.00
NE	3.88	9.01	0.74	0.10	0.00	0.00	0.24	0.92	1.71	0.75	0.01	0.00
ENE	2.18	4.23	1.42	0.14	0.00	0.00	0.42	1.15	1.30	0.65	0.05	0.00
E	1.11	3.02	2.47	0.23	0.00	0.00	0.52	1.67	1.83	0.74	0.06	0.00
ESE	0.84	1.84	1.28	0.10	0.00	0.00	0.42	1.22	1.90	0.90	0.07	0.00
SE	0.57	1.84	1.87	0.43	0.01	0.00	0.42	1.39	2.16	0.93	0.06	0.01
SSE	0.82	2.08	2.84	0.74	0.02	0.02	0.46	1.43	2.13	0.82	0.00	0.00
S	0.86	3.13	3.63	1.66	0.10	0.00						
SSW	0.47	1.27	2.08	0.92	0.06	0.00						
SW	0.24	0.92	1.71	0.75	0.01	0.00						
WSW	0.42	1.15	1.30	0.65	0.05	0.00						
W	0.52	1.67	1.83	0.74	0.06	0.00						
MNW	0.42	1.22	1.90	0.90	0.07	0.00						
NW	0.42	1.39	2.16	0.93	0.06	0.01						
NNW	0.46	1.43	2.13	0.82	0.00	0.00						

DRAWN KRL
 CHKED
 APRVED MJS
 DATE 06-29-92
 JEG NO. 10G30400

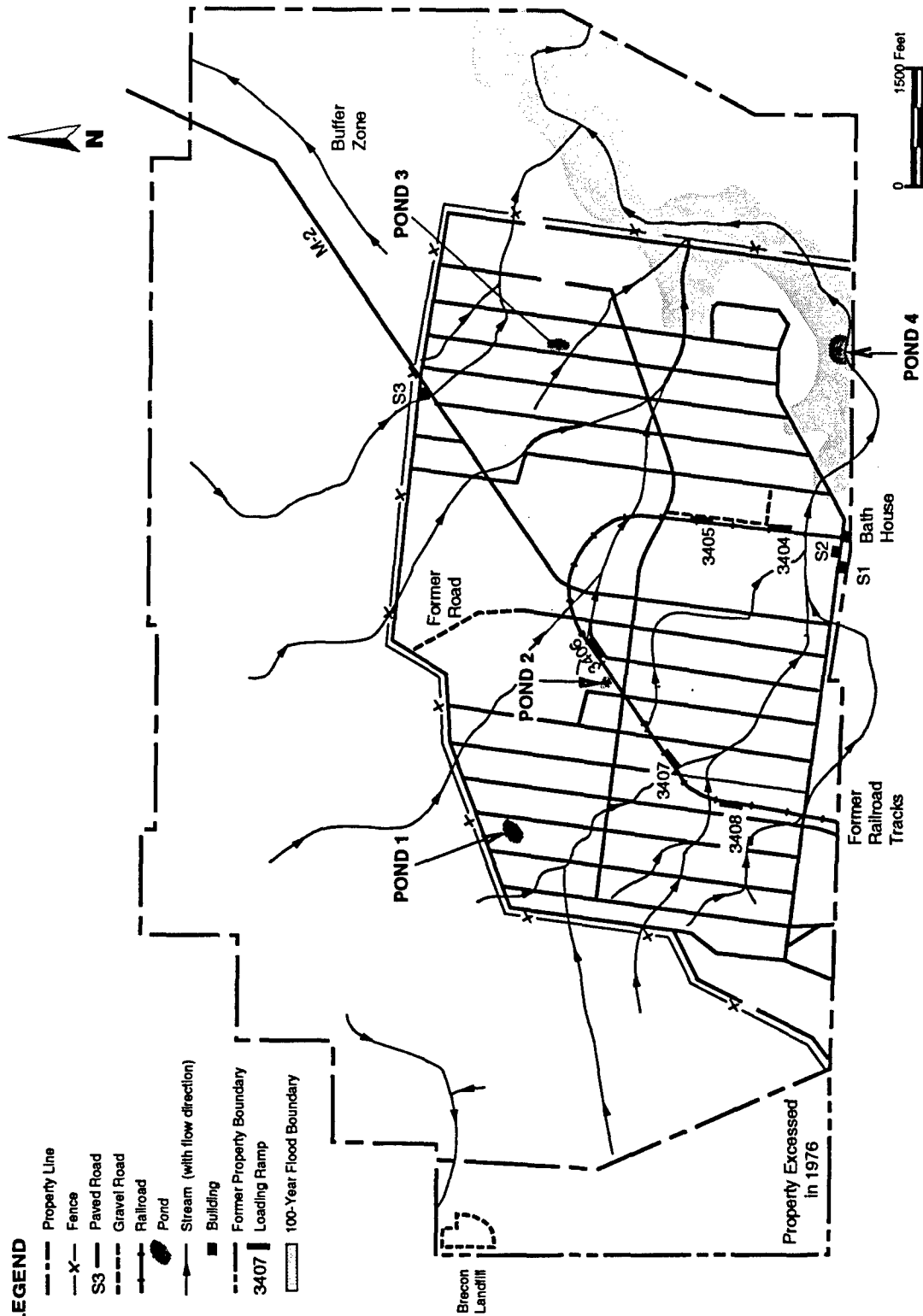
FIGURE 2-1
WIND ROSE
COOSA RIVER STORAGE ANNEX EI

JE JACOBS ENGINEERING GROUP INC. No. G304R21

US Army Corps of Engineers
 Toxic and Hazardous Materials Agency
 Contract No. DAAA15-90-D-0013-0004

LEGEND

- Property Line
- X- Fence
- S3 Paved Road
- Gravel Road
- Railroad
- Pond
- Stream (with flow direction)
- Building
- Former Property Boundary
- 3407 Loading Ramp
- 100-Year Flood Boundary



Source: Dames & Moore, 1990

DRAWN	KFL
CHKD	
APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

FIGURE 2-3

**SURFACE WATER STORAGE ANNEX EI
COOSA RIVER STORAGE ANNEX EI**

JE JACOBS ENGINEERING GROUP INC.

No. G304R23

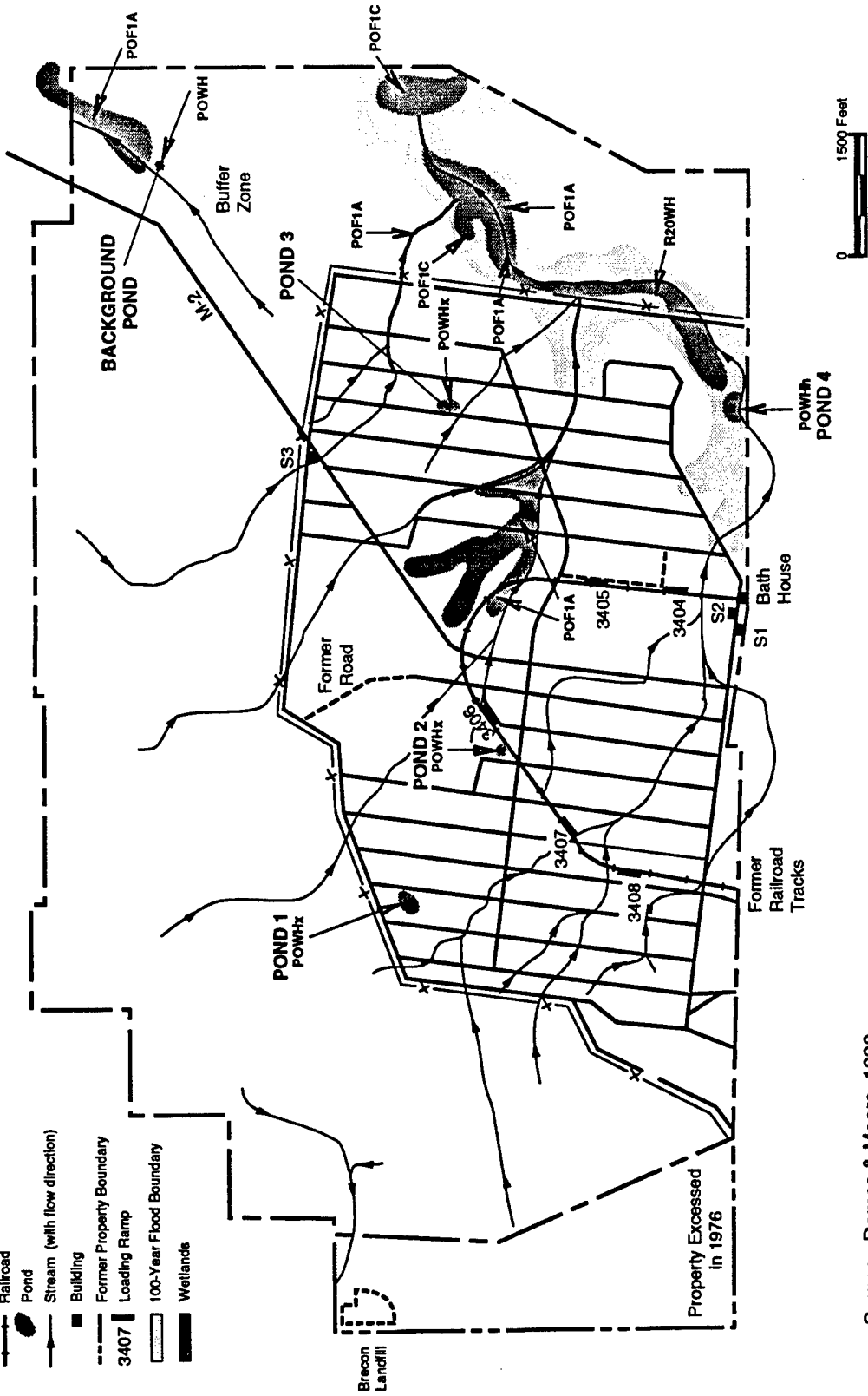


**US Army Corps
of Engineers**
Toxic and Hazardous
Materials Agency

Contract No. DAAA15-90-D-0013-0004

LEGEND

- Property Line
- X- Fence
- S3 Paved Road
- Gravel Road
- Railroad
- Pond
- Stream (with flow direction)
- Building
- Former Property Boundary
- 3407 Loading Ramp
- 100-Year Flood Boundary
- Wetlands



Source: Dames & Moore, 1990

DRAWN	KRL
CHKED	
APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

FIGURE 2 - 4
SITE WETLANDS

COOSA RIVER STORAGE ANNEX EI

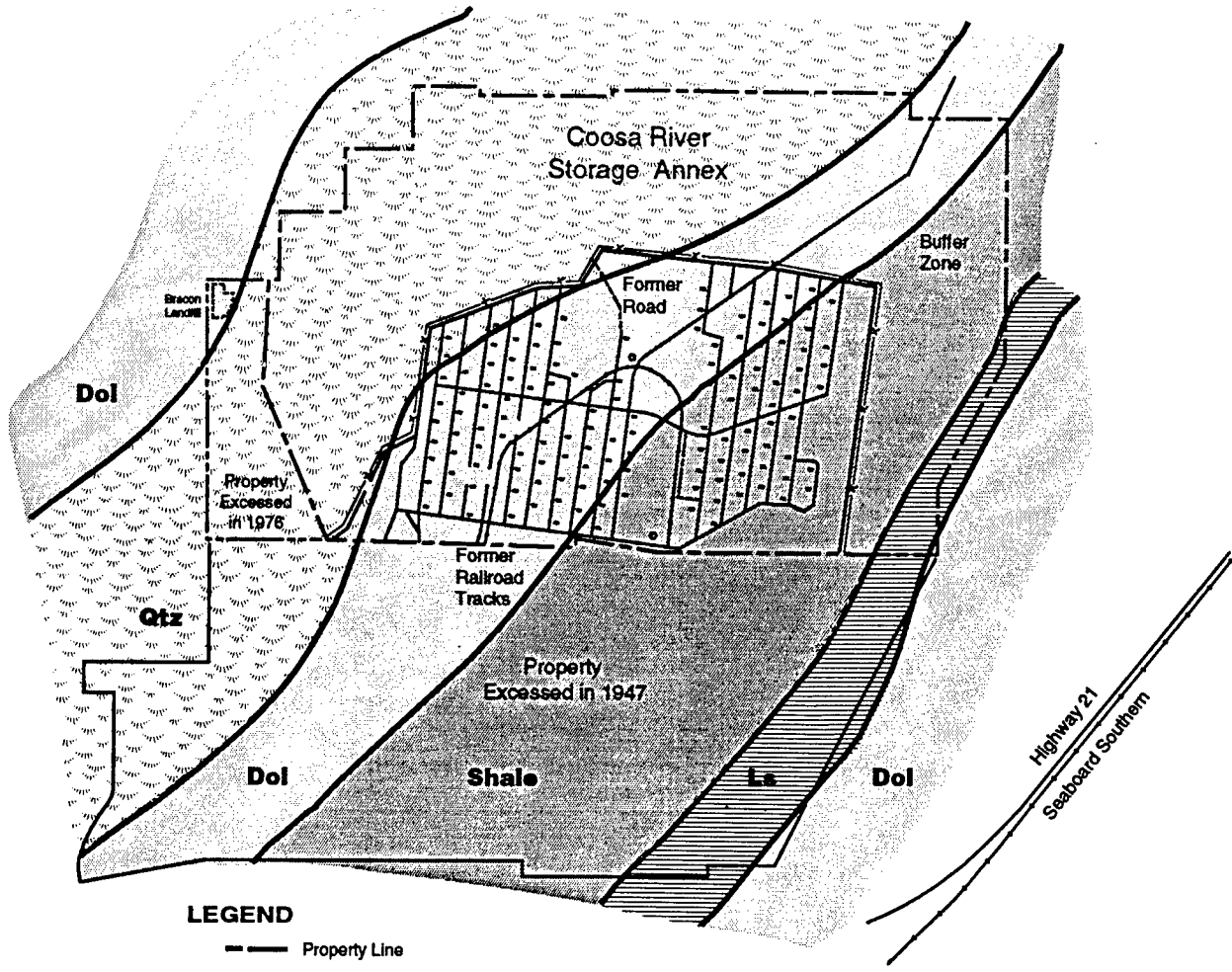
JE JACOBS ENGINEERING GROUP INC.

No. G304R24



US Army Corps of Engineers
Toxic and Hazardous Materials Agency

Contract No. DAAA15-90-D-0013-0004



- LEGEND**
- Property Line
 - x- Fence
 - - - Gravel Road
 - +— Railroad
 - Storage Igloo
 - - - Former Property Boundary
 - Cemetery
 - ▭ Dolomite
 - ▭ Quartzite
 - ▭ Shale
 - ▭ Limestone

Source: Causey, 1965

DRAWN	KRL
CHKED	
APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

FIGURE 2-5

SITE GEOLOGY

COOSA RIVER STORAGE ANNEX EI

JE JACOBS ENGINEERING GROUP INC. No. G304R25

US Army Corps of Engineers

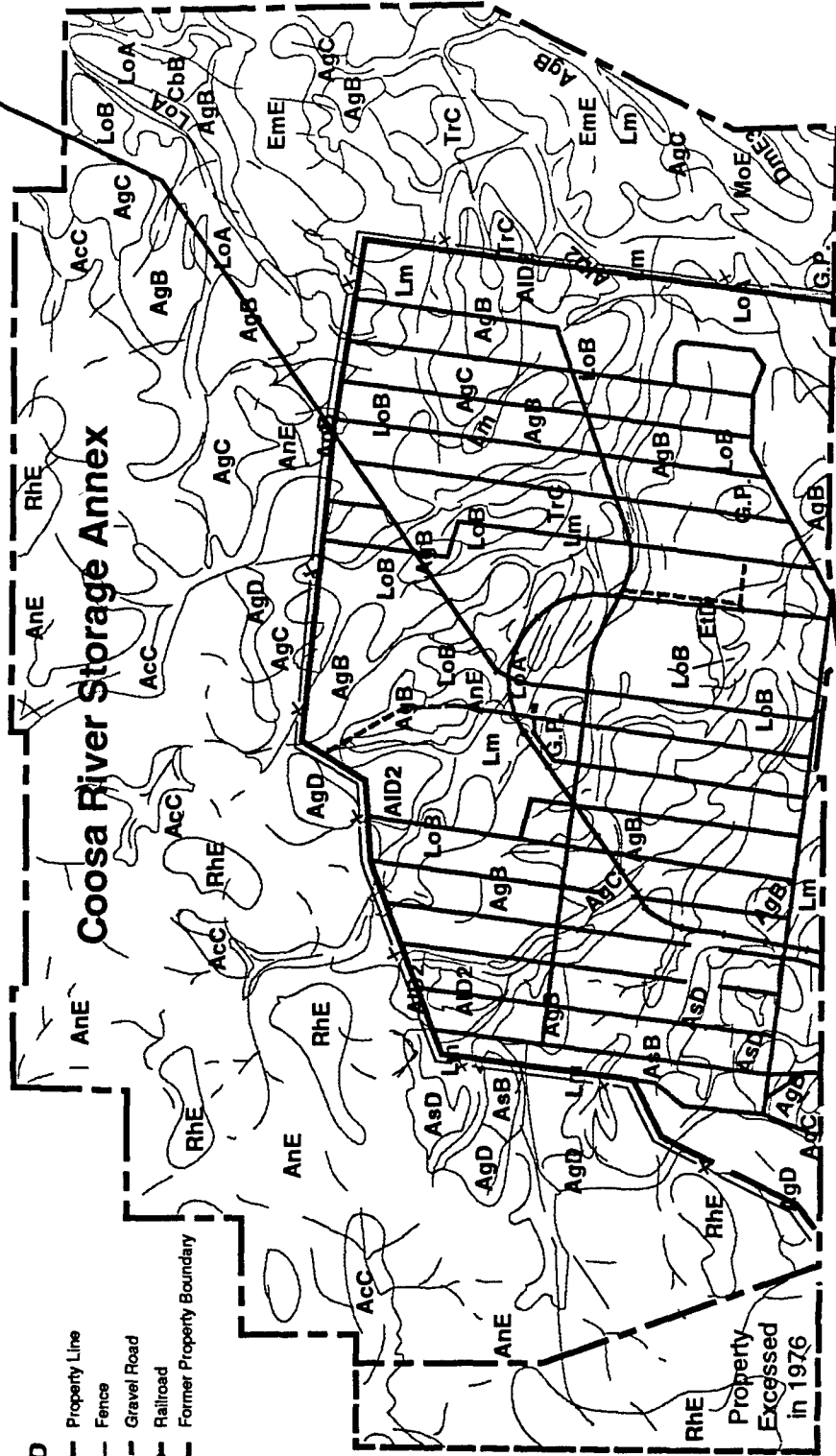
Toxic and Hazardous
Materials Agency

Contract No. DAAA15-90-D-0013-0004

LEGEND

- Property Line
- X- Fence
- - - Gravel Road
- +— Railroad
- - - Former Property Boundary

Coosa River Storage Annex



Not to Scale

- AcC Allen cobbly fine sandy loam
- AgB, AgC, AgD Allen gravelly fine sandy loam
- AIB2, AID2 Allen gravelly sandy clay loam
- AnE Allen association
- AsB, AsD Anniston loam
- CbB Cane fine sandy loam
- Dme3 Dewey clay loam
- Eme Enders-Montevally association
- EID Enders-Townley-Montevally assoc.
- G.P. Orr Gravel or borrow pit
- Lm Lobelville loam
- LoA, LoB Locust silt loam
- MoE Minvale-Bodine association
- RhE Rock land-Hector-Townley assoc.
- TrB, TrC Townley gravelly loam

Source: Cotton, 1974.

DRAWN KFL

CHKED

APPROVED *MJS*

DATE 06-29-92

JEG NO. 10G30400

FIGURE 2-6

SITE SOILS

COOSA RIVER STORAGE ANNEX EI

JE JACOBS ENGINEERING GROUP INC.

No. G304R26

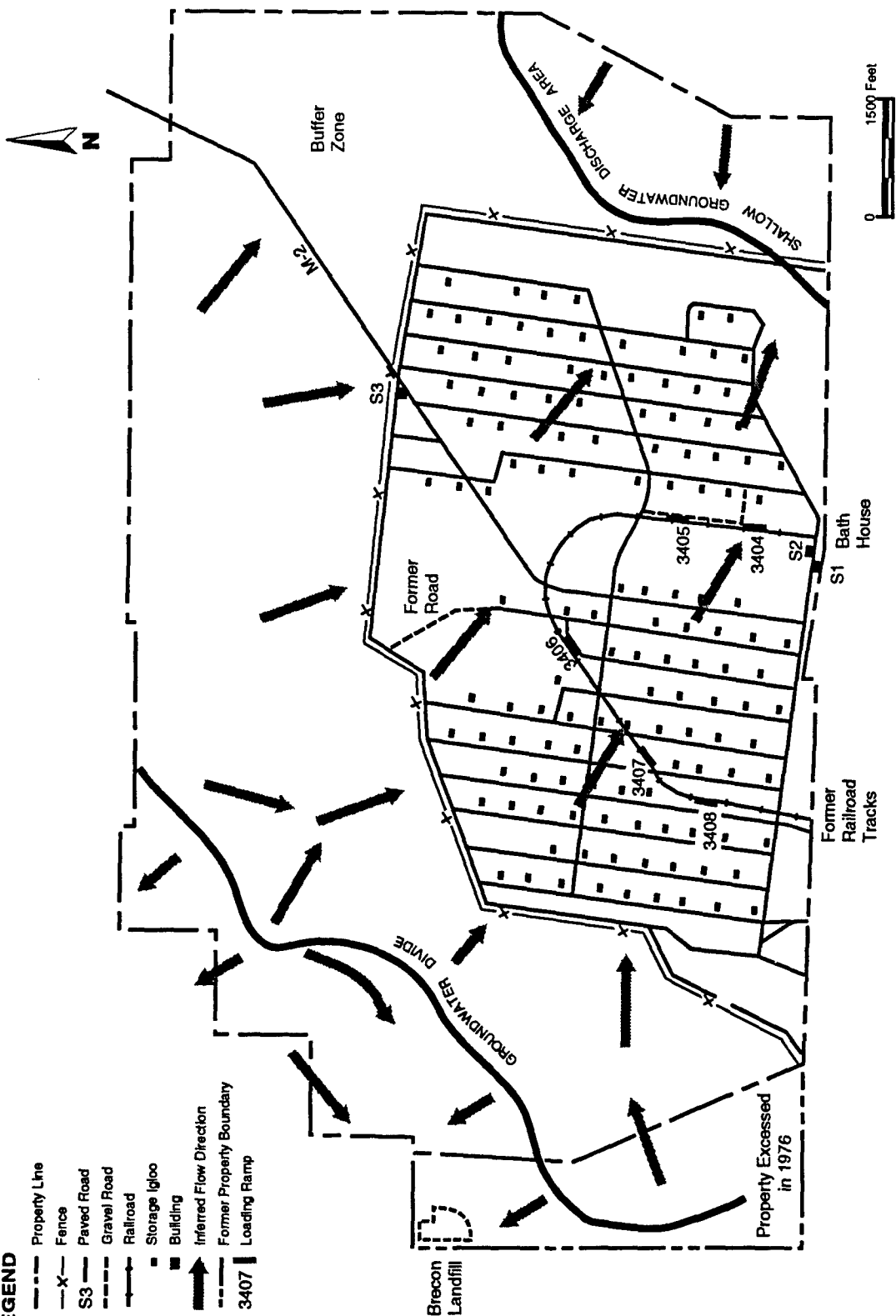


US Army Corps
of Engineers
Toxic and Hazardous
Materials Agency

Contract No. DAAA15-90-D-0013-0004

LEGEND

- Property Line
- X- Fence
- S3 Paved Road
- Gravel Road
- Railroad
- Storage Igloo
- Building
- ➔ Inferred Flow Direction
- - - Former Property Boundary
- 3407 Loading Ramp



Source: Dames & Moore, 1990

DRAWN	KRL
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APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

FIGURE 2-7
INFERRED GROUNDWATER FLOW DIRECTION
COOSA RIVER STORAGE ANNEX EI

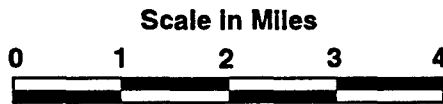
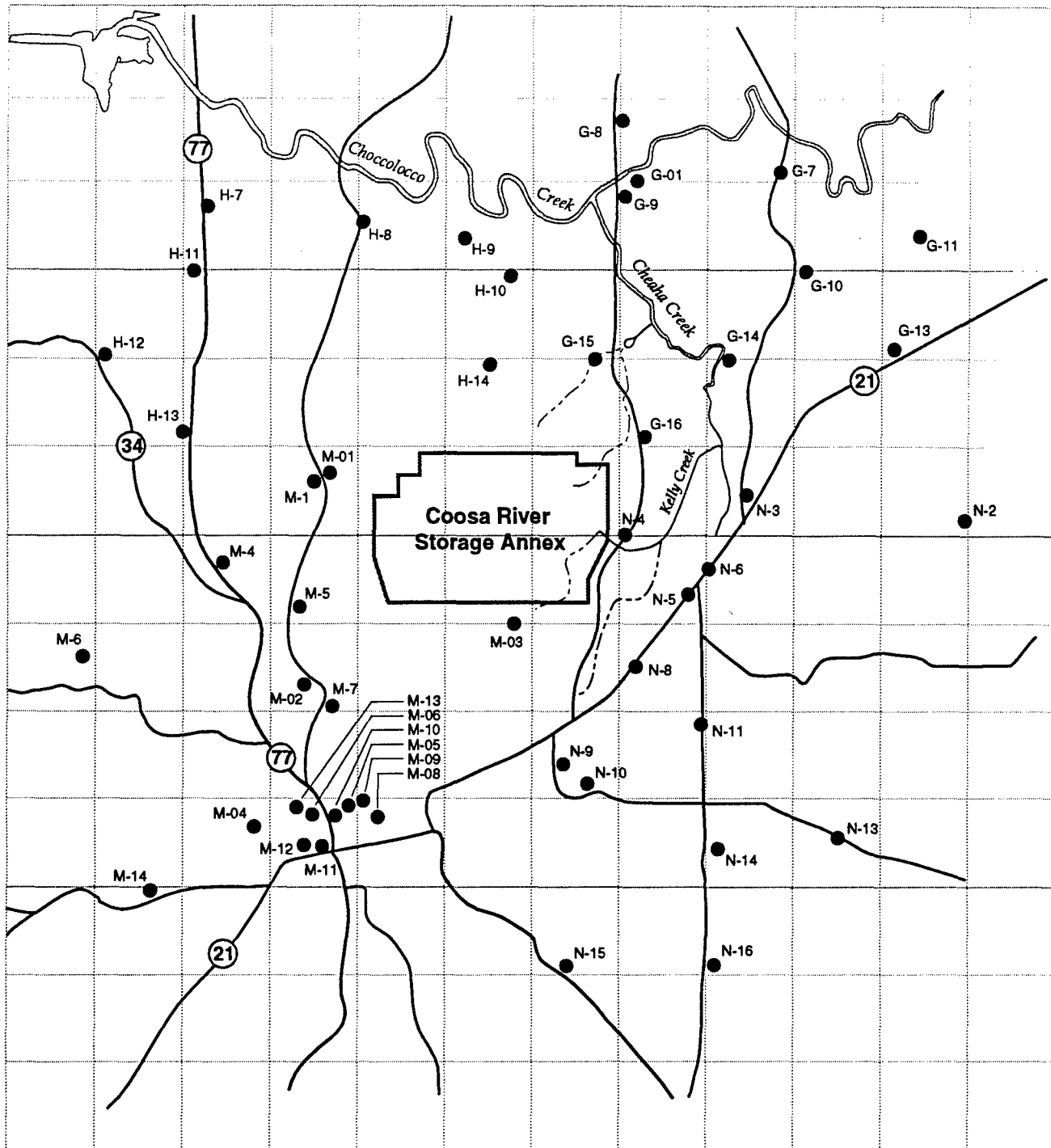
JE JACOBS ENGINEERING GROUP INC.

No. G304R27



US Army Corps of Engineers
 Toxic and Hazardous Materials Agency

Contract No. DAAA15-90-D-0013-0004



Source: Moser, 1988.

DRAWN	KRL
CHKED	
APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

FIGURE 2-8
WELL & SPRING LOCATIONS
COOSA RIVER STORAGE ANNEX EI

JE JACOBS ENGINEERING GROUP INC.

No. G304R28



US Army Corps of Engineers

Toxic and Hazardous Materials Agency

Contract No. DAAA15-90-D-0013-0004

TABLE 2-1

SUMMARY OF SURFACE WATER PATHWAY ELEMENTS
COOSA RIVER STORAGE ANNEX

Migration route description:

- Southeast portion

- o Probable points of entry are where surface runoff leaves the southeast portion of the site via the three small perennial streams along the east edge of the site. All three of these streams are tributaries of a larger perennial tributary of Kelly Creek, which drains in a northeasterly direction away from the site. (Reference 1)
- o The 15-mile downstream distance limit, beginning from the point where the farthest downstream first order tributary of Kelly Creek leaves the southeast portion of the site, just barely enters Logan Martin Lake proper. The instream route of surface water is presented below in sequential order with the corresponding distances within each of the sequential surface water bodies, along with the designated best usage classification established by the State of Alabama for these intrastate water bodies within the Coosa River Basin. (References 1, 2 and 16)

<u>Water body</u>	<u>Estimated flow distance</u>	<u>Cumulative flow distance</u>	<u>Best usage classification</u>
first order tributary	0.3 miles	0.3 miles	A&I ¹
second order tributary	1.4 miles	1.7 miles	A&I ¹
Kelly Creek	2.4 miles	4.1 miles	A&I
Cheaha Creek	3.0 miles	7.1 miles	S/F&W
Choccolocco Creek	7.4 miles	14.5 miles	F&W
Logan Martin Lake	0.5 miles	15.0 miles	S/F&W

Where, in decreasing order of stringency, the best usage categories (Reference 16) are:

S = Swimming and other whole body water-contact sports.

F&W = Fish and wildlife -- fishing, propagation of fish, aquatic life and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food-processing purposes. N.B., ² designates that these bodies are not included by name, but are so classed as tributaries to Choccolocco Creek which is itself classed as F&W.

A&I = Agricultural and industrial water supply -- agricultural irrigation, livestock watering, industrial cooling and process water supplies, and any other usage, except fishing, bathing, recreational activities including water-contact sports, or as a source of water supply for drinking or food-processing purposes. N.B., ¹ designates that these bodies are not included by name, but are so classed as tributaries to Kelly Creek which is itself classed as A&I from this stream stretch to its source.

- Northwest portion

- o Probable points of entry are where surface runoff leaves the northwest portion of the site via the two small perennial streams along the west (one) and north-northwest (one) edges of the site. Both of these streams are tributaries of Choccolocco Creek. (Reference 1)

TABLE 2-1
(sheet 2 of 4)

- o The 15-mile downstream distance limit, beginning from the point where each of the farthest downstream first order tributaries of Choccolocco Creek leaves the northwest portion of the site, enters Logan Martin Lake proper. The instream route of surface water is presented below in sequential order with the corresponding distances within each of the sequential surface water bodies, along with the designated best usage classification established by the State of Alabama for these intrastate water bodies within the Coosa River Basin. (References 1, 2 and 16)

<u>Water body</u>	<u>Estimated flow distance</u>	<u>Cumulative flow distance</u>	<u>Best usage classification</u>
first order tributaries	< 4 miles	< 4 miles	F&W ²
Choccolocco Creek	10.4 miles	< 14.4 miles	F&W
Logan Martin Lake	> 0.6 miles	15.0 miles	S/F&W

Based upon stream gauging information available for the area as presented below, the following values are average flows (Q_{avg}) for the water bodies in cubic feet per second (cfs) (Reference 3):

- o Unnamed tributaries: estimated as less than 3 cfs, based on median annual 7-day low flow with 2-year recurrence interval (7-day Q_2);
- o Kelly Creek: estimated as less than 3 cfs, based on 7-day Q_2 ;
- o Cheaha Creek: estimated to be between 19 cfs and 200 cfs, based upon estimated 7-day Q_2 of 19 cfs near its confluence with Choccolocco Creek;
- o Choccolocco Creek: measured as 695 cfs near confluence with Logan Martin Lake;
- o Coosa River: measured as 12,600 cfs in Logan Martin Lake approximately 4 miles downstream of the confluence of Choccolocco Creek.

STREAM GAUGING INFORMATION
COOSA RIVER STORAGE ANNEX

WATER BODY		7-day Q2		7-day Q10		Qavg	
		MGD	cfs	MGD	cfs	MGD	cfs
Unnamed tributaries	Low:	NA	NA	NA	NA	NA	NA
	High:	< 2	3	NA	NA	NA	NA
Kelly Creek	Low:	NA	NA	NA	NA	NA	NA
	High:	< 2	3	NA	NA	NA	NA
Cheaha Creek	Low:	10	20	NA	NA	NA	NA
	High:	< 100	200	NA	NA	NA	NA
	Estimated:	12	19	NA	NA	NA	NA
Choccolocco Creek	Low:	100	200	NA	NA	NA	NA
	High:	< 1,000	2,000	NA	NA	NA	NA
	Measured:	110	170	78	120	449	695
Coosa River	Low:	> 1,000	2,000	NA	NA	NA	NA
	High:	NA	NA	NA	NA	NA	NA
	Measured:	1,810	2,800	1,290	2,000	8,120	12,600
NOTES:	<p>Reference cites values in MGD (million gallons per day); values in cfs (cubic feet per second) result from mathematical conversion, with number of significant figures determined by reference value.</p> <p>7-day Q2: Median annual 7-day low flow with recurrence interval of 2 years.</p> <p>7-day Q10: Median annual 7-day low flow with recurrence interval of 10 years.</p> <p>Qavg: Average flow.</p> <p>NA: Not available.</p> <p>Source: Harkins, J. R. 1972. Surface-Water Availability, Talladega County, Alabama. Map 112. Geological Survey of Alabama.</p>						

TABLE 2-1
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Drinking water threat:

- No drinking water intakes are known to exist along the 15-mile downstream distance limit identified above. (References 7, 8, 9, 13, and 15)

Human food chain threat (fisheries):

- Alabama Department of Conservation and Natural Resources Division of Game and Fish recognizes the existence of fisheries in Cheaha Creek, Choccolocco Creek, and Logan Martin Lake. This does not preclude the possibility that some form of aquatic organism is occasionally taken from Kelly Creek for human consumption. (Reference 11)
- No information was obtained regarding the production of the aforementioned fisheries.

Environmental threat:

- Choccolocco Creek represents the only potentially sensitive environment identified along the 15-mile downstream distance limit. Choccolocco Creek may represent part of the range of a federally-listed endangered species, the Alabama live-bearing snail *Tulotoma magnifica*. In addition, several species of freshwater mussels with varying conservation statuses may also occur in Choccolocco Creek. Although sampling efforts have not confirmed the occurrence of these organisms, the type and structure of habitats present in Choccolocco Creek indicate such a potential. (References 12 and 14)
- Official identification and delineation of wetlands in Talladega County has not yet been conducted. (Reference 10)
- Visual evaluation of the USGS 7.5-minute quadrangle topographic maps of the area does not indicate the presence of symbols used to identify wetlands.

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TABLE 2-1
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TABLE 2-2

SUMMARY OF WETLANDS
COOSA RIVER STORAGE ANNEX

WETLANDS				
CLASSIFICATION	SYSTEM	CLASS	MODIFIER	SPECIAL MODIFIER
POWHh	Palustrine	Open water (unknown bottom)	Permanently flooded	Diked / impounded
POWHx	Palustrine	Open water (unknown bottom)	Permanently flooded	Excavated
PFO1A	Palustrine	Forested	Broad-leafed deciduous	Temporarily flooded
PFO1C	Palustrine	Forested	Broad-leafed deciduous	Seasonally flooded
R2OWH	Riverine	Lower perennial	Open water (unknown bottom)	Permanently flooded

Source: Adapted from Table A-4, Dames & Moore, 1990; adapted in turn from Weston, 1989, and from U.S. Fish and Wildlife Service National Wetland Inventory, 1981. Talladega, NE, Alabama; Birmingham SE; Birmingham South.

TABLE 2-3

WELLS AND SPRINGS WITHIN A 4-MILE RADIUS OF THE
COOSA RIVER STORAGE ANNEX

WELL NO.	OWNER	DEPTH OF WELL (ft)	DEPTH TO WATER (ft)	SCREENED INTERVAL (ft)	GEOLOGIC UNIT	USE	REMARKS
M-1	Elbert Reynolds	128	79	--	Oek	Domestic	6-in steel casing to 128 ft; high iron content.
M-2	Talladega County Training School	200	19.0	--	Oek	Public	6-in steel casing; along with M-3, supplies water for all school personnel; known as #1 well.
M-3	Talladega County Training School	180	101.2	--	Oek	Public	6-in steel casing; along with M-2, supplies water for all school personnel; known as #2 well.
M-4	Hugh Hutto	180	61	--	Oek	None	6-in steel casing to 82 ft; rock @ 82 ft; destroyed 1986.
M-5	R.A. Obert	225	80	--	Oek	Domestic	6-in steel casing to 225 ft.
M-6	George Davis	172	161.4	--	Oek	Domestic	6-in steel casing.
M-7	Mrs. Fannie Oglesby	95	30.3	--	ecrsc	Domestic	6-in steel casing; supplied 2 houses.
M-8	Newberry Mfg. Co.	257	71	--	ecu	None	8-in casing to 250 ft; abandoned 1986.
M-9	City of Talladega	203	57	--	ecu	Potable	10-in steel casing to 202 ft; located @ Sloan Ave. and 19th St.; known as Sloan Ave. well.
M-10	Alabama Service Company	604	32	--	ecu	None	8-in casing; destroyed 1986.
M-11	City of Talladega	--	--	--	ecu	Spring	Former city supply; known as City Spring.
M-12	Talladega Ice and Storage	--	20	--	ecu	Industrial	6-in steel casing; destroyed 1986.

TABLE 2-3

WELLS AND SPRINGS WITHIN A 4-MILE RADIUS OF THE
COOSA RIVER STORAGE ANNEX

WELL NO.	OWNER	DEPTH OF WELL (ft)	DEPTH TO WATER (ft)	SCREENED INTERVAL (ft)	GEOLOGIC UNIT	USE	REMARKS
M-13	Wehadkee Yarn Mills	237	47	--	ecu	Industrial	6-in steel casing.
M-01	Calvin Jones	92	73	--	Oek	Domestic	6-in steel casing to 90 ft; supplies 4 houses.
M-02	Bobby Johns	107	27	--	ecrsc	Domestic	6-in steel casing; supplies 2 houses.
M-03	City of Talladega	--	--	--	ecrsc	None	Brecon Spring.
M-04	City of Talladega	195	120	--	ecrsc	Public	12-in steel casing to 148 ft; located @ Grant St. & Tanner Dr. in Amanda Bingham Park, known as Grant Street Well.
M-05	City of Talladega	--	26	--	ecrsc	Potable	10-in steel casing; pump set @ 124 ft; located @ Broome St. & North East St., known as Harmon Park Well.
M-06	Wehadkee Yarn Mills	--	73.8	--	ecrsc	Industrial	6-in steel casing; known as Upper Well by mill.
M-*	City of Talladega	381	52.8	--	ecu	Potable	12-in steel casing to 100 ft; located @ Bingham St. & H Ave., known as Bingham St. Well.
N-2	G.N. Chandler	100.2	64.0	--	Oek	Domestic	6-in steel casing; supplies 2 houses.
N-3	Alvin Nelson	15	15	--	ecu	Domestic	30-in dug well, no casing.

TABLE 2-3

WELLS AND SPRINGS WITHIN A 4-MILE RADIUS OF THE
COOSA RIVER STORAGE ANNEX

WELL NO.	OWNER	DEPTH OF WELL (ft)	DEPTH TO WATER (ft)	SCREENED INTERVAL (ft)	GEOLOGIC UNIT	USE	REMARKS
N-4	Gary Myrick	86	20	--	ecrsc	Domestic	6-in casing.
N-5	Janey B. King	28	13	--	Oek	Domestic	5-in steel casing; supplies 2 houses.
N-6	Jim Pruitt	--	--	--	Oek	Spring	Known as Robert McMeillon Spring.
N-8	Mrs. McGee	--	23	--	ecu	Domestic	6-in steel casing; supplies 2 houses.
N-9	J.B. White, Jr.	100	53	--	ecu	None	6-in steel casing.
N-10	J.B. White, Jr.	160	--	--	Oek	--	6-in steel casing.
N-11	Julian Elliot	34	34	--	Qr	None	24-in concrete casing; supply inadequate.
N-13	Howard Lackey	140	103.8	--	Oek	Domestic	6-in steel casing to 137 ft.
N-14	Harry Simmons	85	62	--	Oek	Domestic	6-in casing; supplies 2 houses.
G-14	Mrs. Sarah Whitson	--	--	--	Oek	None	Known as Cedar Spring.
G-15	Col. Woods	140	20	--	Oek	Domestic, Stock	6-in steel casing; supplies 1 house and a few small stock.
G-16	Talladega County Board of Education (Carver School)	--	--	--	Oek	Domestic	6-in steel casing; supplies 2 houses.
H-8	Will Rozell	46	32	--	Qr	None	24-in brick casing, dug well.
H-9	Virgil Buttersworth	66	26	--	Oek	Domestic	6-in steel casing to 22 ft.
H-10	Joe Wallace	36	30	--	Qr	Domestic	24-in concrete casing, dug well.
H-13	T. E. Newsome	108	41	--	Oek	--	6-in steel casing to 108 ft.

TABLE 2-3

WELLS AND SPRINGS WITHIN A 4-MILE RADIUS OF THE
COOSA RIVER STORAGE ANNEX

WELL NO.	OWNER	DEPTH OF WELL (ft)	DEPTH TO WATER (ft)	SCREENED INTERVAL (ft)	GEOLOGIC UNIT	USE	REMARKS
H-14	Roy Champion	21	15	--	Oek	Domestic	30-in diam uncased dug well.
G-7	J.H. Champion	76	23.6	--	Oek	Domestic	6-in casing.
G-8	J.W. Beck	107	15.0	--	ecrsc	Domestic, Stock	6-in casing to 90 ft; supplies one house and 37 head of stock.
G-9	J.H. O'Neil	80	20.8	--	Oek	Domestic	6-in casing to 19 ft; supplies 2 houses and 1 store.
G-10	H.T. Rowell	399	69.0	--	Oek	Domestic	6-in steel casing; supplies 2 houses and garage.
G-13	Esther J. Miller	165	78.5	--	Oek	Domestic	6-in steel casing to 161 ft; supplies 1 house and store.
G-01	J.H. O'Neil	86	52	--	Oek	Domestic	6-in steel casing to 51 ft.
H-7	J.B. Bowden	--	165.2	--	Oek	Domestic, Stock	6-in casing; supplies one house and stock.
H-11	Betty Cunningham	47	24.1	--	Qr	None	Dug well 18-in diameter, no casing.
H-12	Andy C. Barker	193	144.4	--	Oek	Domestic	6-in steel casing to 193 ft; supplies 2 houses.

NOTES:

-- : Information not available.

ecrsc : Rome Formation Shady Dolomite Chilhowee Group, undifferentiated.

ecu : Conasauga Formation (upper).

M-* : Well identified without information in Weston, 1989; not listed in Mosser, 1988; information gathered from City of Talladega and Graves Service Co., their well driller.

Oek : Knox Group, undifferentiated.

Qr : Residium.

Source: Adapted from Table 4-1, Weston, 1989, and Moser, 1988; well numbering as per Mosser, 1988, except for M-*.

TABLE 2-4

RARE PLANTS AND ANIMALS IN TALLADEGA COUNTY, ALABAMA

SCIENTIFIC NAME	COMMON NAME	STATUS
<u>FEDERALLY LISTED PLANT SPECIES:</u>		
<i>Asplenium bradleyi</i>	Bradley's spleenwort	Candidate for endangered status
<i>Helianthus smithii</i>	No common name	Candidate for endangered status
<u>FEDERALLY LISTED ANIMAL SPECIES:</u>		
<i>Pituophis m. melanoleucus</i>	Northern pine snake	Candidate for endangered status
<i>Picoides borealis</i>	Red-cockaded woodpecker	Endangered
<i>Myotis grisescens</i>	Gray bat	Endangered
<i>Myotis sodalis</i>	Indiana bat	Endangered
<u>STATE LISTED ANIMAL SPECIES:</u>		
<i>Heterodon simus</i>	Southern hognose snake	Threatened
<i>Pseudotriton montanus flavissimus</i>	Gulf Coast mud salamander	Poorly known
<i>Graptemys pulchra</i>	Alabama map turtle	Special concern
<i>Ammodramus henslowii</i>	Henslow's sparrow	Poorly known
<i>Plecotus rafinesquii</i>	Rafinesque's big-eared bat	Special concern
<i>Sylvilagus transitionalis</i>	New England cottontail	Poorly known

Source: Adapted from Weston, 1989.

TABLE 2-5
AGE DISTRIBUTION OF PERSONS
RESIDING IN TALLADEGA COUNTY, ALABAMA

Age Group	Percentage of Population	Cumulative Population Distribution
< 5 yrs.	7.7%	7.7%
5 - 24 yrs.	34.5%	42.2%
25 - 44 yrs.	27.1%	69.3%
45 - 64 yrs.	19.2%	88.5%
> 65 yrs.	11.5%	100.0%

Source:	Adapted from Table A-1, Dames & Moore, 1990, adapted in turn from Bureau of the Census, 1988.
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TABLE 2-6
POPULATION TRENDS

YEAR	POPULATION	
	TALLADEGA COUNTY	CITY OF TALLADEGA
1910	37,921	N.A.
1920	41,005	N.A.
Change	8.1%	
1930	45,241	7,596
Change	10.3%	
1940	51,832	9,298
Change	14.6%	22.4%
1950	63,639	13,134
Change	22.8%	41.3%
1960	65,495	17,742
Change	2.9%	35.1%
1970	65,280	17,662
Change	-0.3%	-0.5%
1980	73,826	19,128
Change	13.1%	8.3%
1990	74,107	18,175
Change	0.4%	-5.0%
Overall change	36,186	10,579
	95.4%	139.3%
	1910-1990	1930-1990
NOTES:		
N.A. = Not available.		
Source: Bureau of the Census, 1921, 1952, 1982, 1991.		

3.0 STUDY AREA INVESTIGATIONS

This section briefly presents the rationale for the scope of this EI and presents the data quality objectives (DQOs) of the EI that were first developed in the Technical Plan [Dames & Moore, 1990] and later revised and presented in the Quality Control Plan [Jacobs, 1991]. DQOs are the requirements needed to support decisions relative to the various stages of remedial actions that may be necessary at a site. General DQOs that delineate the extent of effort required by this EI include:

- o Evaluating the potential for current or previous activities at the Annex to have caused environmental contamination.
- o Conducting a preliminary risk assessment of the Annex.
- o Determining the necessity for remedial actions and identifying appropriate preliminary remedial alternatives.

Because of the uncertainty regarding the nature of the operations and waste disposal methods practiced at the Annex, and because of a lack of comprehensive environmental media monitoring data, collection of investigatory samples was required in order to generate data to identify whether contaminants are present in the environment at the Annex.

The data requirements were designed such that the data collected would serve to locate and/or confirm source areas of contamination to the extent necessary to identify preliminary remedial alternatives.

The purpose of the field investigation program conducted in response to these identified data needs was primarily to collect representative samples of surface water, sediment, soils, residual contaminants from "spills", and radon, as necessary, that were to be analyzed to identify potential chemicals of concern at particular site features at the Annex. The location and number of samples were selected to optimize the identification of contaminant sources, and to provide initial data to evaluate potential pathways of contaminant migration.

DQOs and the technical approach used in this EI are presented on Table 3-1. A summary of analytical parameters and techniques implemented in the EI are presented on Table 3-2, while analytical methods and detection limits are presented on Table 3-3. The following sections elaborate on the investigation of the study area.

3.1 BACKGROUND SAMPLES

3.1.1 SOIL

Three background soil samples were collected at the Annex, all within the "buffer zone" outside of the igloo storage area's fence line. The soil samples collected from these background sampling stations are identified in IRDMIS and throughout this report and its appendices with the prefix SSBG. One background soil sample was collected from the buffer zone west of the fence line (Background Station 1, SSBG01), one from the buffer zone north of the fence line (Background Station 2, SSBG02), and one from the buffer zone east of the fence line (Background Station 3, SSBG03).

Soil samples from Background Stations 2 (SSBG02) and 3 (SSBG03) were four-point composites. The original location for the sample from Background Station 1 (SSBG01) was inaccessible by foot. The sampling station was moved east to a point near a stream crossing, which itself was surrounded by standing water. Due to the standing water, only a single point grab sample was collected for SSBG01. Samples were collected from the soil surface to a depth of approximately six inches using a stainless steel hand auger.

The sample aliquots were then composited together in a stainless steel mixing bowl and thoroughly mixed with a stainless steel spoon to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the approved Quality Control Plan (QCP) [Jacobs, 1991] using a stainless steel spoon. This sampling methodology was identical to that used for the soil samples collected during this EI.

Where a four-point composite was collected, each of the four aliquots was collected equidistant along radii fanning out from a central location. The central locations for Background Stations 2 and 3 (SSBG02 and SSBG03, respectively), and the single grab sample location for Background Station 1 (SSBG01), were marked with a wood stake labeled with the sample identification number. A photograph was also taken of each staked background soil sample location. Background soil sample locations are presented on Figure 3-1 as BG01, BG02, and BG03.

All background soil samples were analyzed for the universal soil sample suite of analytical parameters: (1) the metals lead (Pb) and mercury (Hg); (2) nitrocellulose (NC); (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl; (4) BETX, consisting of the analytes benzene, ethylbenzene, toluene, and xylenes; and (5) TRPH, total recoverable petroleum hydrocarbons. This suite of analytical parameters corresponds to the complete universe of analytes for all soil samples collected during this EI.

Each background soil sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991]. This preservation methodology was identical to that used for all soil samples collected during this EI.

The soil samples collected from these background sampling stations are identified in IRDMIS and throughout this report and its appendices as SSBG01, SSBG02 and SSBG03, respectively.

3.1.1.1 Deviations from Approved Plans

The original location for the sample from Background Station 1 (SSBG01) was inaccessible by foot due to standing water. The sampling station was moved east to a point near a stream crossing, which itself was surrounded by standing water. Due to the standing water, only a single point grab sample was collected for SSBG01, rather than the four-point composite sample as designated in the approved Sampling Design Plan [Dames & Moore, 1990] and the approved QCP [Jacobs, 1991]. The soil sample collected from this background sampling station is identified in IRDMIS and throughout this report and its appendices as SSBG01. Appendix B presents a comparison of planned vs. actual sampling activity by location, matrix and analytes.

3.1.2 WETLAND POND

The wetland pond background sample station, Station 11, was selected to provide surface water and sediment samples representative of the same wetland class as the excavated ponds at the Annex. As presented on Figure 2-4, all ponds sampled during the EI are classified as Pallustrine system, open water class, permanently flooded (classification POWH). Ponds 1 through 3 on the Annex have the special modifier "x" (i.e., classification POWHx), which indicates that they are excavated (see Tables 1-8 and 2-2). Since Pond 4 is impounded by a beaver dam, as observed during the field investigation of this EI, it has been tagged with the special modifier "h" (i.e., classification POWHh).

The wetland pond background sample location, Background Station 11, was staked in a manner identical to that used for the four "excavated ponds." The point of exit from the pond, identical to the point of entry to the pond, was marked with a wood stake labelled with the sample identification numbers of the samples from the pond. A photograph was also taken of the staked location. The wetland pond background sample location, Background Station 11, is presented on Figure 3-1 as BG11.

3.1.2.1 Surface Water

A wetland pond background surface water grab sample was collected at Station 11 from a location that was most accessible using hip waders. Care was taken to minimize disturbance of both the water surface being sampled and the sediment in the pond. In-situ temperature, pH and specific conductivity were measured and noted in the field log book prior to collecting the sample volume. Each of the appropriate sample bottles as specified in the QCP [Jacobs, 1991] was rinsed by immersing the bottle approximately six inches under the water surface until it completely filled with water from the pond, emptying the bottle, and repeating this process two times. After completing this rinse process, the sample was then collected directly into the sample bottle using the same filling technique. This sample collection methodology was identical to that used for all pond surface water samples collected during this EI.

The wetland pond background surface water sample was analyzed for the same suite of analytical parameters as the sediment sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl. This suite of analytical parameters corresponds to the complete universe of analytes for all pond surface water samples collected during this EI.

The wetland pond background surface water sample was preserved by addition of the appropriate preservative solution, and then placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991]. This preservation methodology was identical to that used for all pond surface water samples collected during this EI.

The surface water sample collected from this sampling station is identified in IRDMIS and throughout this report and its appendices as SWBG11.

3.1.2.2 Sediment

A wetland pond background sediment sample was collected at Station 11 which consisted of a four-point composite sample taken from four locations around the pond bottom and drainage pathway. Locations were chosen on the basis of seep locations and drainage characteristics such as in- and outflow points at the ponds. Each sample aliquot was collected from the sediment-water interface to a depth of approximately 12 inches using a stainless steel hand auger. In accordance with the approved Sampling Design Plan [Dames & Moore, 1990] and the approved QCP [Jacobs, 1991], only the 6 - 12 inch portion of the sample was utilized; the

first 6 inch portion of the sample was discarded by returning it to the pond. The four extracted sediment aliquots were transferred to a stainless steel mixing bowl and thoroughly mixed to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the QCP [Jacobs, 1991] using a stainless steel spoon. This sample collection methodology was identical to that used for all pond sediment samples collected during this EI.

The wetland pond background sediment sample was analyzed for the same suite of analytical parameters as the surface water sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl. This suite of analytical parameters corresponds to the complete universe of analytes for all pond sediment samples collected during this EI.

The wetland pond background sediment sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991]. This preservation methodology was identical to that used for all pond sediment samples collected during this EI.

The sediment sample collected from this sampling station is identified in IRDMIS and throughout this report and its appendices as SEBG11.

3.2 STORAGE IGLOOS

3.2.1 RADON GAS SAMPLING

Radon gas sampling was conducted at the Annex in accordance with the Department of the Army's Radon Protocol for Base Closure. Under this protocol, the Army has divided the testing of buildings into three priority classes, which refer to the importance or impacts that high radon levels might have in accordance with the historic or projected future usage of the building.

Priority I buildings include family housing, billets, day care facilities, hospitals and schools which are often used 24 hours a day for occupancy. Priority II buildings include training centers, operations centers, and research and development/technology facilities, which may be used for 24-hour operations. Priority III buildings cover other facilities, office buildings, laboratories, shops, and warehouses, where use is normally restricted to eight (8) hours or less per day.

Radon gas sampling was conducted at selected storage igloos at the Annex, which fall under Priority III under this protocol. Alpha track radon detectors were placed in 14 of the 136 igloos. Igloos monitored for radon gas include 2902, 2903, 2905, 2906, 2908, 2909, 2910, 3005, 3006, 3007, 3008, 3009, 3010, and 3011. Duplicate alpha track samplers were placed in Igloos 2905, 2909, and 3010.

All alpha track radon detectors were placed in the back right corner of the igloo in order to minimize the effects of any unplanned opening of the igloo doors during the anticipated 90-day collection period. Detectors were elevated approximately two inches above the floor by placement upon a block of wood. Detectors were placed in all igloos on 29 January 1991, and retrieved on 8 May 1991 for shipment to the analytical laboratory, an actual 107-day collection period.

3.2.2 WIPE SAMPLING

Wipe samples of interior surfaces were collected at all but two of the 136 igloos at the Annex. Since no keys could be located for the locks on Igloos 1901 and 3101, lack of access to the interior of the igloos prevented collection of a sample from these two igloos. Four-point wipe samples were taken of interior surfaces to determine the presence of any surficial contamination. Wipe sampling was conducted using stainless steel tongs to wipe one gauze pad each across the four 10 cm x 10 cm areas within an igloo, so that an individual sample consisted of one gauze pad. Each four-point composite consisted of one wall wipe, one floor wipe, and one wipe from each of the two drainage channels along the igloo side walls. Each of the 10 cm x 10 cm areas from which a wipe sample was collected was marked with an "X" chalk marking. One sample area from within each igloo sampled was photographed to document sample methods.

Each wipe sample gauze pad was prepared and preserved in a manner determined by the analyte of interest. Gauze pads were soaked in 5 mL of the appropriate solvent as specified in the approved QCP [Jacobs, 1991] inside the sample container prior to conducting the wipe. Another 5 mL of that same solvent was used to preserve the sample.

Gauze pads for the analysis of nitroaromatics/explosives were soaked in 5 mL of acetonitrile prior to conducting the wipe, and then were preserved in 5 mL of acetonitrile. Gauze pads for the analysis of nitrocellulose used acetone as the solvent/preservative; those for the analysis of total recoverable petroleum hydrocarbons (TRPH) used Freon; and those for the analysis of polychlorinated biphenyls (PCBs) used hexane. All wipe sample bottles were then preserved by placing the sample bottle on ice and maintaining them at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

All igloo wipe samples were analyzed for the same baseline suite of analytical parameters: (1) NC; and (2) nitroaromatics/explosives -- consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

The wipe samples from Igloos 1910, 2007, 2904, 3108, 3301, and 3302, in addition to the baseline suite of parameters, were sampled and analyzed for: (1) TRPH; and (2) PCBs, consisting of PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, and PCB-1260.

3.2.2.1 Deviations from Approved Plans

The Sampling Design Plan [Dames & Moore, 1990] specified use of either filter paper or a gauze pad to collect the wipe sample, while the approved QCP [Jacobs, 1991] specified use of filter paper. Field sampling deviated from the QCP by using gauze pads as specified in the Sampling Design Plan.

Figures in the approved Sampling Design Plan [Dames & Moore, 1990] identified the existence of Igloos 2401, 2709 and 3109, and hence specified these igloos as sampling stations for wipe samples. The approved QCP [Jacobs, 1991], developed from the Sampling Design Plan, likewise specified these igloos as sampling stations for the collection of wipe samples. During the field sampling activity of this EI, it was determined that none of these three igloos exists. Therefore, no wipe samples were collected at these preselected sampling stations.

Figures in the approved Sampling Design Plan did not identify the existence of Igloos 2404, 2711 and 3110, and hence did not specify them as sampling stations. The approved QCP likewise did not specify these igloos as sampling stations. Igloos 2404, 2711 and 3110 were identified during the field sampling activity of this EI and, consistent with the goals of the EI, were thus designated in the field as sampling stations for wipe samples. The wipe samples collected from these sampling stations are identified in IRDMIS and throughout this report and its appendices as WP2404, WP2711, and WP3110, respectively. Table 3-4 presents a comprehensive listing of all igloos present at the Annex (as identified at the completion of the field investigation of this EI).

Since no keys could be located for the locks on Igloos 1901 and 3101, lack of access to the interior of the igloos prevented collection of a sample from these two igloos. Appendix B presents a comparison of planned vs. actual sampling activity by location, matrix and analytes.

3.2.3 SOIL SAMPLING

As discussed in Section 1.3.4.2.1, each storage igloo at the Annex has two shallow drainage channels that run the length of the side walls. These channels each lead to separate screened drains approximately four inches in diameter located in the front wall. These drains discharge directly to the surface soils outside of the igloos. These discharge points are the locations from which two-point composite soil samples were collected from each of the 136 igloos at the Annex. Table 3-4 explains individual igloo numbering by row. An aliquot from the discharge point below each drain was collected from the soil surface to a depth of approximately six inches using a stainless steel hand auger. The two aliquots were then composited together in a stainless steel mixing bowl and thoroughly mixed with a stainless steel spoon to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the QCP [Jacobs, 1991] using a stainless steel spoon. The first of the two aliquot collection points was marked with a wood stake labelled with the sample identification number. A photograph was also taken of each igloo soil sample location.

All igloo soil samples were analyzed for the same baseline suite of analytical parameters: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

The soil sample from Igloo 1607, in addition to the baseline suite of parameters, was analyzed for: (1) BETX and (2) total recoverable petroleum hydrocarbons (TRPH).

Each igloo soil sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.2.3.1 Deviations from Approved Plans

Figures in the approved Sampling Design Plan [Dames & Moore, 1990] identified the existence of igloos 2401, 2709 and 3109, and hence specified these igloos as sampling stations for soil samples. The approved QCP [Jacobs, 1991], developed from the Sampling Design Plan, likewise specified these igloos as sampling stations for the collection of soil samples. During the field sampling activity of this EI, it was determined that none of these three igloos exists. Therefore, no soil samples were collected at these preselected sampling stations.

Figures in the approved Sampling Design Plan did not identify the existence of Igloos 2404, 2711 and 3110, and hence did not specify them as sampling stations. The approved QCP likewise did not specify these igloos as sampling stations. Igloos 2404, 2711 and 3110 were identified during the field sampling activity of this EI and, consistent with the goals of the EI,

were thus designated in the field as sampling stations for soil samples. The soil samples collected from these sampling stations are identified in IRDMIS and throughout this report and its appendices as SS2404, SS2711, and SS3110, respectively. Table 3-4 presents a comprehensive listing of all igloos present at the Annex (as identified at the completion of the field investigation of this EI). Appendix B presents a comparison of planned vs. actual sampling activity by location, matrix and analytes.

3.3 LOADING RAMP AREAS

As discussed in Section 1.3.4, five loading ramps exist at the Annex along a former looped railroad spur. Four four-point composite soil samples were taken from the soil areas around loading ramp 3404. Two four-point composite soil samples, and two grab soil samples were taken from the soil areas around loading ramp 3405. One four-point composite soil sample was taken from the soil area around ramp 3406. One four-point composite soil sample was taken from the soil area around ramp 3407. One four-point composite soil sample and three two-point composite soil samples were taken from the soil areas around loading ramp 3408. Each sample location was selected in the field so as to yield a sample that was representative of the soils in that area. Sample locations are presented on Figure 3-1.

Each sample was collected from the ground surface to a depth of approximately six inches using a stainless steel hand auger. The extracted soil was transferred to a stainless steel mixing bowl and thoroughly mixed with a stainless steel spoon to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the QCP [Jacobs, 1991] using a stainless steel spoon. Each sample collection point was marked with a wood stake labelled with the sample identification number. A photograph was also taken of each loading ramp soil sample location.

Each loading ramp soil sample was analyzed for the same baseline suite of analytical parameters: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Each loading ramp soil sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.3.1 DEVIATIONS FROM APPROVED PLANS

Figures in the approved Sampling Design Plan [Dames & Moore, 1990] misidentified Loading Ramp 3405 as 3403, and hence specified that loading ramp as a sampling station for soil

samples. The approved QCP [Jacobs, 1991], developed from the Sampling Design Plan, likewise specified that misidentified loading ramp as a sampling station for the collection of soil samples. During the field sampling activity of this EI, it was determined that the loading ramp is properly identified as 3405 (see Section 1.3.4.2.2). Therefore, the soil samples collected from this sampling station are identified in IRDMIS and throughout this report and its appendices as SS3405A, SS3405B, SS3405C, SS3405CMS, and SS3405D.

Figures in the approved Sampling Design Plan did not identify the existence of Loading Ramps 3406 and 3407, and hence did not specify them as sampling stations. The approved QCP likewise did not specify these loading ramps as sampling stations. Loading Ramps 3406 and 3407 were identified during the field sampling activity of this EI (see Section 1.3.4.2.2) and, consistent with the goals of the EI, were thus designated in the field as sampling stations for soil samples. The soil samples collected from these sampling stations are identified in IRDMIS and throughout this report and its appendices as SS3406 and SS3407, respectively. Table 3-4 presents a comprehensive listing of all loading ramps present at the Annex (as identified at the completion of the field investigation of this EI). Appendix B presents a comparison of planned vs. actual sampling activity by location, matrix and analytes.

3.4 DEBRIS PILE

As discussed in Section 1.3.4.2.3, the debris pile consists of empty wooden packing crates, empty wooden ammunition boxes, wooden pallets, empty mortar shell casings, and general paper waste. Four surface soil grab samples were collected from the soil beneath the debris pile. Two samples were collected on the north side of the debris pile, one from each corner; likewise, two samples were taken from the south side of the debris pile, one from each corner. Sample locations are presented on Figure 3-1.

Each sample was collected from the ground surface to a depth of approximately six inches using a stainless steel hand auger. The extracted soil was transferred to a stainless steel mixing bowl and thoroughly mixed with a stainless steel spoon to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the QCP [Jacobs, 1991] using a stainless steel spoon. Each sample collection point was marked with a wood stake labelled with the sample identification number. A photograph was also taken of each debris pile soil sample location.

Each debris pile soil sample was analyzed for the same baseline suite of analytical parameters: (1) the metals Pb and Hg; (2) NC; (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl; (4) BETX; and (5) TRPH.

Each debris pile soil sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.5 GROUND DISTURBANCES

Twenty one ground disturbances identified during previous planning activities as discussed in Section 1.3.4.2.4 were sampled during this EI. Due to the considerable lapse of time between the shutdown of the Annex, and the time between the various planning activities and this EI, considerable overgrowth of vegetation complicated locating the disturbances while in the field. The sampling team relied heavily on aerial photographs as well as previous documented field observations while locating the ground disturbances.

Ground disturbances 7, 12, 14 and 15 are large disturbances, and were split into two different samples, an "A" sample and a "B" sample. The other ground disturbances consisted of a single undifferentiated sample. Sample locations are presented on Figure 3-1.

Each sample location consisted of a four-point composite. Each composite area was selected in the field so as to yield a sample that was representative of the entire ground disturbance area. Each aliquot of the composite was collected from ground surface to a depth of approximately six inches using a stainless steel hand auger. The four aliquots were then composited together in a stainless steel mixing bowl and thoroughly mixed with a stainless steel spoon to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the QCP [Jacobs, 1991] using a stainless steel spoon. Each of the four aliquot collection points was marked with a wood stake labelled with the sample identification number. A photograph was also taken of sample location.

All ground disturbance soil samples were analyzed for the same baseline suite of analytical parameters: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Each ground disturbance soil sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.6 EXCAVATED PONDS

Four ponds located at the Annex were sampled for both surface water and sediments during this EI. The surface water sample from a pond was collected prior to collection of the sediment sample from that pond. As discussed in Section 1.3.4.2.5, only three of the ponds

seem to have been excavated and show ground scarring characteristic of excavation. The fourth pond, Pond 4, located west of the southern end of B-7 (identified as R19 in previous reports), was observed during the field investigation of this EI to be a low-lying area where water accumulates due to the presence of a beaver dam. No evidence of excavation was observed in the area of Pond 4. Sample locations are presented on Figure 3-1.

Sample locations for the ponds were staked differently than locations of other samples during the EI due to the nature of the samples, sample collection technique, and sample locations. The point of exit from each pond, identical to the point of entry to the pond, was marked with a wood stake labelled with the sample identification numbers of the samples from that pond. A photograph was also taken of the staked location.

3.6.1 SURFACE WATER SAMPLING

A surface water grab sample from each of the four ponds was collected from a location that was most accessible using hip waders. Care was taken to minimize disturbance of both the water surface being sampled and the sediment in the pond. In-situ temperature, pH and specific conductivity were measured in each pond and noted in the field log book prior to collecting the sample volume. Each of the appropriate sample bottles as specified in the QCP [Jacobs, 1991] were rinsed by immersing the bottle approximately six inches under the water surface until it completely filled with water from the pond, emptying the bottle, and repeating this process two times. After completing this rinse process, the sample was then collected directly into the sample bottle using the same filling technique.

Each pond surface water sample was analyzed for the same baseline suite of analytical parameters as the sediment sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Each pond surface water sample was preserved by addition of the appropriate preservative solution, and then placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.6.2 SEDIMENT SAMPLING

Sediment samples collected from each of the four ponds consisted of a four-point composite sample taken from four locations around the pond bottom and drainage pathway of each pond. Locations were chosen on the basis of seep locations and drainage characteristics such as in-

and outflow points at the ponds. Each sample was collected from the sediment-water interface to a depth of approximately 12 inches using a stainless steel hand auger. In accordance with the approved Sampling Design Plan [Dames & Moore, 1990] and the approved QCP [Jacobs, 1991], only the 6 - 12 inch portion of the sample was utilized; the first 6 inch portion of the sample was discarded by returning it to the pond. The four extracted sediment aliquots were transferred to a stainless steel mixing bowl and thoroughly mixed to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the QCP [Jacobs, 1991] using a stainless steel spoon. The DQOs and technical approach for collecting excavated pond sediment samples are presented in Table 3-1.

Each pond sediment sample was analyzed for the same baseline suite of analytical parameters as the surface water sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Each pond sediment sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.7 STREAMS

Streams located at the Annex were sampled for both surface water and sediments during this EI. Six locations on the Annex were sampled, as well as two locations upstream of the Annex and two locations downstream of the Annex. Sample locations are presented on Figure 3-1.

The surface water sample from a stream was collected prior to collection of the sediment sample from that stream.

Sample locations for the streams were staked in a manner similar to that used for the ponds. The point along the stream bank from which the samples were collected was marked with a wood stake labelled with the sample identification numbers of the samples from that stream. A photograph was also taken of the staked location.

3.7.1 SURFACE WATER SAMPLING

A surface water grab sample from each of the 10 stream sampling stations was collected from a location that was most accessible using hip waders. Care was taken to minimize disturbance of both the water surface being sampled and the sediment in the stream. In-situ temperature, pH and specific conductivity were measured in-situ at each stream sampling station and noted

in the field log book prior to collecting the sample volume. Each of the appropriate sample bottles as specified in the QCP [Jacobs, 1991] were rinsed by immersing the bottle approximately six inches under the water surface until it completely filled with water from the stream, emptying the bottle, and repeating this process two times. After completing this rinse process, the sample was then collected directly into the sample bottle using the same filling technique.

Each stream surface water sample was analyzed for the same baseline suite of analytical parameters as the sediment sample collected from that stream: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Each stream surface water sample was preserved by addition of the appropriate preservative solution, and then placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.7.2 SEDIMENT SAMPLING

Sediment grab samples were collected from each of the stream sampling stations. Each sample was collected from the streambed-water interface to a depth of approximately 12 inches using a stainless steel hand auger. Only the 6 - 12 inch portion of the sample was utilized; the first 6 inch portion of the sample was discarded by returning it to the stream downstream of the sampling point. The extracted sediment was transferred to a stainless steel mixing bowl and thoroughly mixed to obtain a homogeneous sample volume. Appropriate sample volumes were then placed into the sample containers specified in the QCP [Jacobs, 1991] using a stainless steel spoon.

Each stream sediment sample was analyzed for the same baseline suite of analytical parameters as the surface water sample collected from that stream: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Each stream sediment sample was preserved by placing the collected sample on ice and maintaining it at a temperature of 4°C, in accordance with the approved QCP [Jacobs, 1991].

3.8 OTHER FIELD DEVIATIONS

Individual field data record sheets for each sample location were not utilized for the Coosa Site Investigation. Logbooks were used and contain all information of the work being done on a daily basis. Books were dated and signed by the field leader in charge at the conclusion of each day.

Any information on instruments used in the investigation that were meant to be calibrated at the start of an event as well as throughout the day are kept in the logbook. Due to the nature of the field work, pH-temperature-conductivity meters were the only instruments used that needed calibration. These instruments were used only a short time, approximately 2 to 4 days.

On 3 June 1991, a small canister approximately the size of a one-half gallon paint can was discovered in front of Igloo 2605 while clearing vegetation from in front of the igloo to obtain a soil sample. The cannister was discovered when it was struck by an EI field technician who was clearing tall grass from the area with a sickle. Upon striking the cannister the field technician observed small amounts of white smoke or vapors rising from the cannister. The label on the cannister read:

6850-00-753-4827
Decontamination Agent DS-2
Contents - 1 1/3 QT CN
ML-D50030
Lot PLY 834233-051
1/83
D2A2 09-81-C-2233
Poly Research Corp
Deerpark, NY 11729

After obtaining information from the cannister label from a safe distance, the EI field team left the area and contacted the Environmental Contact at ANAD, who in turn contacted the ANAD Hazardous Materials Team, who then remediated the cannister. EI field personnel remained off of the Annex site until the cannister was taken care of. The cannister was photographed by an EI field technician, and the incident was recorded in the site logbook.

3.9 DECONTAMINATION PROCEDURES

All sampling instruments such as augers, spoons, bowls and tongs were decontaminated between each sample location with an alconox/water wash followed by a deionized water

rinse. Instruments were then wrapped in aluminum foil to prevent contamination while enroute between sample locations.

TABLE 3-1

DATA QUALITY OBJECTIVES & TECHNICAL APPROACH
COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

STUDY SITE / DQO	PURPOSE / RATIONALE	TECHNICAL APPROACH
STORAGE IGLOOS		
1) Soil quality data	Detect presence of nitroaromatics and metals in shallow soils outside igloos. Determine potential exposure pathway from igloos through drains to surrounding soils. Detect presence of hydrocarbons at "spill" noted by Igloo 1607.	Collect one composite soil sample from each igloo, to include samples from shallow soil adjacent to drains in the front of each igloo. Analyze all samples for nitroaromatics and metals and analyze the samples from Igloo 1607 for TRPH & BETX as well.
2) Need for decontamination of igloo surfaces	Detect residual presence of nitroaromatics in all igloos from previous storage of explosives and from "spills" identified in Igloos 3301 and 3302.	Collect one composite wipe sample from each igloo, to include 4 wipe samples from the floor and drainage channels. Analyze all samples for nitroaromatics and analyze samples from Igloos 1910, 2007, 2904, 3108, 3301, and 3302 for TRPH and PCBs as well.
3) Presence of radon	Detect levels of radon present in igloos.	Collect and analyze radon samples from 10 percent of the 136 igloos (for a total of 14 investigative samples).
DEBRIS PILE		
1) Soil quality data	Detect presence of nitroaromatics, metals, and TRPH in surface soils as the result of waste disposal activities.	Collect 4 shallow grab soil samples (depth 0 to 6 inches) from area. Analyze samples for nitroaromatics, metals, and TRPH.

TABLE 3-1

DATA QUALITY OBJECTIVES & TECHNICAL APPROACH
 COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

STUDY SITE / DQO	PURPOSE / RATIONALE	TECHNICAL APPROACH
GROUND DISTURBANCES		
1) Soil quality data	Detect presence of nitroaromatics and metals in shallow soils as the result of burning or waste disposal activities potentially conducted.	Collect one composite soil sample from each small area and two composite soil samples from each large area. Four soil samples will be composited from the depths of 0 to 6 inches for each sample. Analyze samples for nitroaromatics and metals.
EXCAVATED PONDS		
1) Surface water quality	Detect presence of nitroaromatics and metals in surface water of ponds as the result of previous burning or waste disposal activities potentially conducted.	Collect one surface water sample from each pond. Analyze each sample for nitroaromatics and metals.
2) Sediment quality data	Detect presence of nitroaromatics and metals in sediments of ponds as the result of previous burning or waste disposal activities potentially conducted.	Collect one composite sediment sample, comprising four separate samples, from each pond. Analyze samples for nitroaromatics and metals.
LOADING RAMP AREAS		
1) Soil quality data	Detect presence of nitroaromatics and metals in surface soils as the result of previous activities.	Collect four composite shallow soil samples (depth 0 to 6 inches) from each loading ramp area. Collect 2 of 4 samples from Loading Ramp 3405 adjacent to "coal/ash vessel". Analyze samples for nitroaromatics and metals.

TABLE 3-1
 DATA QUALITY OBJECTIVES & TECHNICAL APPROACH
 COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

STUDY SITE / DQO	PURPOSE / RATIONALE	TECHNICAL APPROACH
SITE WIDE		
1) Surface water/sediment quality	Evaluate potential for contaminant releases from various sites to streams flowing through the Annex.	Collect 2 upstream (background) surface water/sediment samples, 6 onsite samples from the developed area of the Annex, and 2 downstream samples from streams leaving the Annex. Analyze samples for nitroaromatics and metals.
2) Background surface water, soil & sediment data	Evaluate natural concentrations of analytes in media at the Annex.	Collect 3 shallow soil samples composited from four samples 0 to 6 inches deep. Sampling locations should be from the buffer zone from soils associated with each of the three different lithologic units. Analyze samples for metals. Collect background surface water and sediment samples representative of wetland class of excavated ponds from same type of wetland in the northeast buffer zone.

NOTES:

BETX = Benzene, ethylbenzene, toluene, and xylenes.
 Metals include lead (Pb) and mercury (Hg).
 Nitroaromatics include 2,4-DNT; 2,6-DNT; 2,4,6-TNT; tetryl; NC; NB; 1,3-DNB; and 1,3,5-TNB.
 PCBs include PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, and PCB-1260.
 TRPH = total recoverable petroleum hydrocarbons.
 Source: Adapted from Table 5-1, Jacobs, 1991.

TABLE 3-2
 SUMMARY OF ANALYTICAL PARAMETERS & TECHNIQUES
 COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

MEDIA	PARAMETER	TECHNIQUE	USATHAMA CERTIFICATION CLASS	EPA DQO LEVEL
SOIL/ SEDIMENT	Lead (Pb)	GFAA	1	IV
	Mercury (Hg)	CVAA	-	III
	Nitrocellulose (NC)	HPLC	1A	IV
	Nitroaromatics	HPLC	1A	IV
	BETX	GC/PID	1A	IV
	TRPH	GC/PID	-	III
SURFACE WATER	Lead (Pb)	GFAA	1	IV
	Mercury (Hg)	CVAA	-	III
	Nitrocellulose (NC)	HPLC	1A	IV
	Nitroaromatics	HPLC	1A	IV
	pH (field)	Potentiometric	-	I
	Specific Conductance (field)	Wheatstone Bridge	-	I
	Temperature (field)	Thermometric	-	I
		HPLC	1B	III
WIPE SAMPLES	Nitrocellulose (NC)	HPLC	1B	III
	Nitroaromatics	HPLC	1B	III
	PCBs	GC/ECD	1B	III
	TRPH	GC/PID	-	III
	Radon	Enumeration	-	I
GROSS ALPHA TRACK RADON DETECTORS				
SOURCE WATER	Lead (Pb)	GFAA	1	IV
	Mercury (Hg)	CVAA	-	III
	Nitrocellulose (NC)	HPLC	1A	IV
	Nitroaromatics	HPLC	1A	IV
	PCBs	GC/ECD	1B	IV
	BETX	GC/PID	1A	IV
	TRPH	IR	-	III

TABLE 3-2
 SUMMARY OF ANALYTICAL PARAMETERS & TECHNIQUES
 COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

MEDIA	PARAMETER	TECHNIQUE	USATHAMA CERTIFICATION CLASS	EPA DQO LEVEL
EQUIPMENT	Lead (Pb)	GFAA	1	IV
RINSATE	Mercury (Hg)	CVAA	-	III
	Nitrocellulose (NC)	HPLC	1A	IV
	Nitroaromatics	HPLC	1A	IV
	PCBs	GC/ECD	1B	IV
	BETX	GC/PID	1A	IV
	TRPH	IR	-	III
	BETX	Benzene, ethyl benzene, toluene and xylenes		
	CVAA	Cold Vapor Atomic Absorption Spectrometry		
	DQO	Data Quality Objective		
	GC/ECD	Gas Chromatography/Electron Capture Detector		
	GC/MS	Gas Chromatography/Mass Spectrometry		
	GC/PID	Gas Chromatography/Photo Ionization Detector		
	GFAA	Graphite Furnace Atomic Absorption Spectrometry		
	HPLC	High Performance Liquid Chromatography		
	IR	Infrared Spectroscopy		
	Nitroaromatics	2,4-DNT; 2,6-DNT; 2,4,6-TNT; NB; 1,3-DNB; 1,3,5-TNB; and tetryl.		
	PCBs	Polychlorinated biphenyls -- PCB-1016; PCB-1221; PCB-1232; PCB-1242; PCB-1248; PCB-1254; and PCB-1260.		
	TRPH	Total recoverable petroleum hydrocarbons		
	Source:	Adapted from Table 5-2, Jacobs, 1991.		

NOTES:

TABLE 3--3
ANALYTICAL PARAMETERS, METHODS & DETECTION LIMITS
COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

MATRIX / MEDIA	PARAMETER	TECHNIQUE	USATHAMA METHOD	EPA METHOD	DETECTION RANGE	COMMENT
SOIL / SEDIMENT	Lead (Pb)	GFAA	JD21	7421	0.467 - 20.00 ug/g	
	Mercury (Hg)	CVAAs	Y9	7471	0.05 - 1.00 ug/g	
	Nitrocellulose (NC)	HPLC	LF05	8330	**	
	Nitroaromatics:					
	2,4,6-TNT	HPLC	LW23	8330	2.00 - 500 ug/g	
	2,4-DNT	HPLC	LW23	8330	2.50 - 250 ug/g	
	2,6-DNT	HPLC	LW23	8330	2.00 - 500 ug/g	
	Nitrobenzene (NB)					
	1,3-DNB	HPLC	LW23	8330	1.14 - 500 ug/g	
	1,3,5-TNB	HPLC	LW23	8330	0.504 - 250 ug/g	
	Tetryl	HPLC	LW23	8330	0.922 - 250 ug/g	
	BETX:					
	Benzene	GC/PID	AA9	8020	2.11 - 500 ug/g	Soil only
	Ethylbenzene	GC/PID	AA9	8020	0.085 - 5 ug/g	
	Toluene	GC/PID	AA9	8020	0.16 - 10 ug/g	
	1,3-xylene	GC/PID	AA9	8020	0.19 - 2 ug/g	
	Xylene	GC/PID	AA9	8020	0.26 - 5 ug/g	
TRPH	GC/PID	00	8020	0.39 - 2 ug/g		
WIPE SAMPLES	Nitrocellulose (NC)	HPLC	99	8330	10 ug/g	Soil only
	Nitroaromatics:					
	2,4,6-TNT	HPLC	99	8330	4 ug/g	
	2,4-DNT	HPLC	99	8330	5 ug/g	
	2,6-DNT	HPLC	99	8330	4 ug/g	
	Nitrobenzene (NB)					
	1,3-DNB	HPLC	99	8330	2.28 ug/g	
	1,3,5-TNB	HPLC	99	8330	1.01 ug/g	
	Tetryl	HPLC	99	8330	1.84 ug/g	
						4.22 ug/g

TABLE 3--3
ANALYTICAL PARAMETERS, METHODS & DETECTION LIMITS
COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

MATRIX / MEDIA	PARAMETER	TECHNIQUE	USATHAMA METHOD	EPA METHOD	DETECTION RANGE	COMMENT
	PCBs:					
	PCB-1016	GC/ECD	99	8080		
	PCB-1221	GC/ECD	99	8080		
	PCB-1232	GC/ECD	99	8080		
	PCB-1242	GC/ECD	99	8080		
	PCB-1248	GC/ECD	99	8080		
	PCB-1254	GC/ECD	99	8080		
	PCB-1260	GC/ECD	99	8080		
	TRPH	GC/PID	99	8020		
GROSS ALPHA TRACK RADON DETECTORS	Radon	Enumeration				
SURFACE WATER	Lead (Pb)	GFAA	SD18	239.2/7421	4.47 - 200 ug/L	
	Mercury (Hg)	CVAA	CC8	245.1/7470	0.10 - 2.00 ug/L	
	Nitrocellulose (NC)	HPLC	UF05	8330	**	
	Nitroaromatics:					
	2,4,6-TNT	HPLC	UW25	8330	0.426 - 40 ug/L	
	2,4-DNT	HPLC	UW25	8330	0.397 - 20 ug/L	
	2,6-DNT	HPLC	UW25	8330	0.600 - 40 ug/L	
	Nitrobenzene (NB)	HPLC	UW25	8330	0.682 - 40 ug/L	
	1,3-DNB	HPLC	UW25	8330	0.458 - 20 ug/L	
	1,3,5-TNB	HPLC	UW25	8330	0.210 - 20 ug/L	
	Tetryl	HPLC	UW25	8330	0.631 - 40 ug/L	
	pH (field)	Potentiometric		150.1/9040		
	Specific Conductance (field)	Wheatstone Bridge		120.1/9050		
	Temperature (field)	Thermometric				

TABLE 3-3
ANALYTICAL PARAMETERS, METHODS & DETECTION LIMITS
COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

MATRIX / MEDIA	PARAMETER	TECHNIQUE	USATHAMA METHOD	EPA METHOD	DETECTION RANGE	COMMENT
SOURCE WATER/ EQMT RINSATE	Lead (Pb)	GFAA	SD18	239.2/7421	4.47 - 200 ug/L	QA/QC
	Mercury (Hg)	CVAAs	CC8	245.1/7470	0.10 - 2.00 ug/L	QA/QC
	Nitrocellulose (NC)	HPLC	**	8330	**	QA/QC
	Nitroaromatics:					QA/QC
	2,4,6-TNT	HPLC	UW25	8330	0.426 - 40 ug/L	QA/QC
	2,4-DNT	HPLC	UW25	8330	0.397 - 20 ug/L	QA/QC
	2,6-DNT	HPLC	UW25	8330	0.600 - 40 ug/L	QA/QC
	Nitrobenzene (NB)	HPLC	UW25	8330	0.682 - 40 ug/L	QA/QC
	1,3-DNB	HPLC	UW25	8330	0.458 - 20 ug/L	QA/QC
	1,3,5-TNB	HPLC	UW25	8330	0.210 - 20 ug/L	QA/QC
	Tetryl	HPLC	UW25	8330	0.631 - 40 ug/L	QA/QC
	PCBs:					QA/QC
	PCB-1016	GC/ECD	UH20	608	0.385 - 10.0 ug/L	QA/QC
	PCB-1221	GC/ECD	UH20	608		QA/QC
	PCB-1232	GC/ECD	UH20	608		QA/QC
	PCB-1242	GC/ECD	UH20	608		QA/QC
	PCB-1248	GC/ECD	UH20	608		QA/QC
	PCB-1254	GC/ECD	UH20	608		QA/QC
	PCB-1260	GC/ECD	UH20	608		QA/QC
	BETX:	GC/PID	AV8	624	0.176 - 10.0 ug/L	QA/QC
	Benzene	GC/PID	AV8	624	1.05 - 20 ug/L	QA/QC
	Ethylbenzene	GC/PID	AV8	624	1.37 - 39.7 ug/L	QA/QC
	Toluene	GC/PID	AV8	624	1.47 - 39.7 ug/L	QA/QC
	1,3-xylene	GC/PID	AV8	624	1.32 - 39.9 ug/L	QA/QC
	Xylene	GC/PID	AV8	624	1.36 - 39.6 ug/L	QA/QC
	TRPH	IR		418.1		QA/QC

TABLE 3-3
 ANALYTICAL PARAMETERS, METHODS & DETECTION LIMITS
 COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

MATRIX / MEDIA	PARAMETER	TECHNIQUE	USATHAMA METHOD	EPA METHOD	DETECTION RANGE	COMMENT
NOTES:	BETX	Benzene, ethyl benzene, toluene, xylenes				
	PCBs	Polychlorinated biphenyls				
	TRPH	Total recoverable petroleum hydrocarbons				
	GC/MS	Gas Chromatography/Mass Spectrometry				
	GC/ECD	Gas Chromatography/Electron Capture Detector				
	GC/PID	Gas Chromatography/Photo Ionization Detector				
	CVAA	Cold Vapor Atomic Absorption Spectrometry				
	GFAA	Graphite Furnace Atomic Absorption Spectrometry				
	HPLC	High Performance Liquid Chromatography				
	ICP	Inductively Coupled Argon Plasma				
	IR	Infrared Spectroscopy				
	**	USATHAMA analytical method in process of being certified.				
	Source:	Adapted from Table 5-3, Jacobs, 1991.				

TABLE 3-4

IGLOOS AND LOADING RAMPS PRESENT AT THE
COOSA RIVER STORAGE ANNEX

	01	02	03	04	05	06	07	08	09	10	11	12	13	Row Count	Annex Count	
IGLOOS	15	1501	1502	1503	1504	1505	1506	1507	1508	1509				9	9	
	16	1601	1602	1603	1604	1605	1606	1607		1609				8	17	
	17	1701	1702	1703	1704	1705	1706	1707	1708	1709	1710			10	27	
	18				1804	1805	1806	1807	1808	1809				6	33	
	19	1901	1902	1903	1904		1906	1907	1908	1909	1910			9	42	
	20	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010			10	52	
	21	2101	2102	2103	2104	2105			2108					6	58	
	22	2201	2202	2203	2204	2205	2206							6	64	
	23	2301	2302	2303	2304	2305		2307	2308		2310			8	72	
	24		2402	2403	2404	2405	2406	2407						6	78	
	25	2501	2502	2503										3	81	
	26		2602	2603	2604	2605	2606			2608	2609		2612	2613	10	91
	27	2701	2702	2703	2704	2705		2707	2708		2710	2711			9	100
	28	2801	2802	2803	2804		2806	2807	2808	2809	2810				9	109
	29	2901	2902	2903	2904	2905	2906		2908	2909	2910				9	118
	30	3001	3002	3003		3005	3006	3007	3008	3009	3010	3011			10	128
	31	3101	3102				3106	3107	3108		3110				6	134
	33	3301	3302												2	136
	LOADING RAMPS				3404	3405	3406	3407	3408						5	5

NOTES:

Row numbering begins at 15; there is no row 32.

Blanks denote non-existence of the structure.

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination at the Coosa River Storage Annex were determined through source characterization analysis as presented in Section 1.0, and through sampling of potentially affected media as described in Section 3.0.

4.1 QA/QC REVIEW OF EI DATA

4.1.1 PRECISION

Precision is defined as the degree of agreement between repeated measurements of the same parameter under similar circumstances. Precision of the data set was measured by determining the relative percent difference (RPD). RPD was calculated as follows:

$$RPD = 100 \times \left\{ \frac{(D_1 - D_2)}{(D_1 + D_2)} \right\} / 2$$

Where, RPD = Relative percent difference,
D₁ = first duplicate value, and
D₂ = second duplicate value.

The precision of the analytical data was verified by the CLASS Laboratory Quality Assurance Coordinator prior to data entry into the Installation Restoration Data Management Information System (IRDMIS). Any data which did not meet the criteria of the USATHAMA-approved analytical methodology was rejected by IRDMIS and could not be retrieved for use in this report.

The CLASS Laboratory also submits a Quality Assurance Status Report to USATHAMA in accordance with their contract with USATHAMA. Copies of the Quality Assurance Status Reports were forwarded to the EI Contractor for review. These reports contain a narrative of the data lot analysis. In the Quality Assurance Status Reports received by the EI Contractor, the CLASS Laboratory did not indicate any problems with precision of the analysis of the Coosa River Storage Annex data lots. Therefore, all data retrieved from IRDMIS and discussed within this report may be assumed to be of acceptable analytical precision.

RPDs were calculated for the field replicate sample results. In general, the precision of the field sampling effort was good. The following subsections present a more detailed analysis by analytical parameter.

4.1.1.1 Lead (Pb)

For the analysis of lead in a laboratory replicate stream sample pair, sample SE05 and the re-analysis of that sample (SE05R), the RPD was found to be 62%.

For lead in soil samples, where matrix interferences are expected, several outliers were noted in the field replicate (R) and laboratory replicate analyses.

<u>Parameter</u>	<u>Sample Nos.</u>	<u>RPD</u>
Pb	SS1607/R	81%
Pb	SS1706/R	126%
Pb	SS1906/R	72%
Pb	SS2203/R	113%
Pb	SS2304/R	41%
Pb	SS2501/R	146%
Pb	SS2605/R	45%
Pb	SS2804/R	45%
Pb	SS2910/(lab rep)	53%

4.1.1.2 Mercury (Hg)

Two outliers were noted in the analysis of replicate samples for mercury (Hg). Samples SS3106/R were found to differ by 67% RPD and results for samples SS1607/R were found to have an RPD of 57%. All other RPD values were found to be within acceptable limits (RPD $< \pm 35\%$).

4.1.1.3 Nitrocellulose (NC)

In the analysis of replicate samples for nitrocellulose (NC), several outliers were noted. The most serious discrepancy was noted for the analysis of samples SS1906/R. Nitrocellulose was detected in sample SS1906 at 42.7 ug/g, while 2,500 ug/g was detected in SS1906R. For the purposes of the risk assessment, the higher value was used; however, to confirm a more accurate concentration of nitrocellulose in this sample, it may be necessary to re-analyze this sample.

In sample SS1805, nitrocellulose was below the detection limit of 23.1 ug/g, while the replicate sample indicated 183 ug/g. These results also significantly deviate from one another.

Other outliers in the replicate analyses of nitrocellulose samples which were not as significant as those described above include:

<u>Parameter</u>	<u>Sample Nos.</u>	<u>RPD</u>
NC	SS1503/R	84%
NC	SS1607/R	73%
NC	SS2605/R	66%
NC	SS3010/R	59%
NC	SS3106/R	68%
NC	SSGD08/R	56%
NC	WP1706/R	138%
NC	WP1805/R	45%
NC	WP1906/R	82%
NC	WP2304/R	151%
NC	WP2905/R	94%
NC	WP3010/R	68%
NC	WP3106/R	146%

4.1.1.4 Nitroaromatics/Explosives

Generally, the RPDs for the field replicates were good. The only two outliers are as follows:

<u>Parameter</u>	<u>Sample No.</u>	<u>RPD</u>
2,4-DNT	SS1805/R	75%
NB	WP1503/R	167%

All other RPD values were found to be within acceptable limits (RPD < \pm 35%).

4.1.1.5 TRPH

One outlier was noted for the replicate analysis of TRPH (abbreviated in IRDMIS as TPHC) samples. In samples SS1607/R, the RPD was 57%. All other RPD values were found to be within acceptable limits (RPD < \pm 35%).

4.1.2 ACCURACY

Accuracy is defined as the degree of agreement between an analyzed value and the accepted or known value. Accuracy of the data analysis was determined in the CLASS Laboratory by the analysis of spiked samples. By spiking a representative sample from each sample lot with a known concentration of the analyte of interest, a percent recovery (%R) was calculated as follows:

$$\%R = (S_a/S_b) \times 100$$

Where, %R = Percent recovery,
S_a = spike concentration determined by analysis, and
S_b = known concentration of spike.

In accordance with the Final QCP [Jacobs, 1991], environmental matrix spike samples were collected in the field and submitted to the CLASS Laboratory for analysis to provide another check on the accuracy of the data set. In many cases, the results for the matrix spike samples are reported as less than the detection limits. Therefore, it is suspected that environmental sample matrices other than the building interior surfaces matrix (wipe samples) were not spiked in accordance with the requirements of the QCP, but were instead analyzed as replicate samples. As a result, it is not possible to make conclusions regarding the matrix spike submittal and analyses for matrices other than the wipe samples.

Building interior surfaces (wipe sample) matrix spike samples, however, were spiked in accordance with the QCP. Results reported in IRDMIS for building interior surfaces (wipe sample) matrix spike samples include the spike amount (i.e., are uncorrected for the spike amount).

According to USATHAMA methodologies, the CLASS Laboratory was required to analyze both a high and low concentration spike for each parameter and each media. The laboratory's Quality Assurance Status Reports discuss the results of the high and low spike analyses by lot. A discussion of the accuracy of the data set by lot is presented in the following paragraphs.

4.1.2.1 Lot OPF

Low spike recoveries were outlier high for 1,3,5-TNB; however, all of the field samples were reported as less than the detection limits. No data were affected.

For RDX analyzed in this lot, all samples reported as less than the detection limits were unacceptable due to low spike recoveries. The IRDMIS data report for this lot was verified and results were reported for all parameters except RDX in this lot. It should be noted that RDX was neither specified in the QCP nor on any analytical request sheets submitted with the samples during this EI to the CLASS laboratory.

4.1.2.2 Lots OPL, OPK, OTX, OSB, OTY, and OVU

The status report stated that "targets were adjusted" to reflect the concentration of an old spiking solution that was inadvertently used. A new solution was spiked into lot OTY and the results were acceptable. One field sample, SS3405D, was reported as biased low for nitrocellulose due to a low spike recovery for Lot OPK. Results for this sample were reported to be 258 ug/g.

4.1.2.3 Lot ORT

Spike recoveries were low for the analysis of 1,3,5-TNB. All results which were reported as less than the detection limits were considered to be unusable. Samples affected included: SSDP01 through SSDP04, SSGD07A and SSGD07B, SSGD12A and SSGD12B, SSGD14A and SSGD14B, and SSGD15A and SSGD15B.

4.1.2.4 Lot OSF

The low spike recovery for the analysis of nitrocellulose was outlier high, as discussed in the laboratory's Quality Assurance Status Report; however, this data was not retrievable from Level 3 of IRDMIS. Three samples, identified as 5, 6, and 7 in the lot, were reportedly affected. While the CLASS Laboratory identified this lot as belonging to the Coosa River EI, it is possible that this was in error and that this lot is part of another USATHAMA data set.

4.1.2.5 Lot OUF

For the analysis of nitrocellulose in Lot OUF, the laboratory reported that the blanks contained a value near to that reported in samples SS2806, SS2807MS, and SS2808. These values should be considered as less than the detection limit.

4.1.2.6 Lots OVM and OVN

High spike recoveries were outlier high for all analytes except 2,4-DNT. All the positive results should have been coded as estimated; however, there were no positive results in these lots for analytes other than 2,4-DNT. No data were affected.

4.1.2.7 Lot OVQ

The low spike recovery for the analysis of lead was biased high. All field samples were higher than the high spike amount; therefore, no data were qualified.

4.1.2.8 Lot OXF

The high spike recovery for the compound benzene was lower than the CLASS Laboratory control limit; however, the recovery was within the acceptable limits of accuracy specified by the EPA guidance SW-846, Method 8240. No data were qualified.

4.1.2.9 Lot OXL

High spike recoveries were outlier low for the analysis of 2,4-DNT. Field sample results were all less than the detection limits; therefore, no data were qualified.

4.1.2.10 Lots OXO and OZW

Wipe samples in Lot OZW were analyzed for nitrocellulose only. Within this lot, sample WP2807MS was spiked by the CLASS Laboratory with 50 ug of nitrocellulose and the spike recovery was 50 percent. This low spike recovery was most likely due to matrix interferences as noted in the laboratory data package. As a result, the nitrocellulose data for samples WP1807, WP1903, WP2007, WP2008, WP2009, WP2010, WP2307, WP2502, WP2603, WP2604,

WP2606, WP2608, WP2609, WP2620, WP2613, WP23106, WP2807MS and WP3106R within Lot OZW should be considered to be biased low due to the low matrix spike recovery for WP2807MS.

In Lot OXO, sample WP3108MS was also spiked by the CLASS Laboratory and analyzed for nitrocellulose. The matrix spike recovery for this sample was 74 percent, which is slightly below the acceptable range of 75 percent. As a result, no data in this lot should be qualified.

4.1.2.11 Lot OXS

Wipe samples within Lot OXS were analyzed for explosives. Matrix spike sample WP3108MS was analyzed within this data set. All explosive compounds reported were spiked by the CLASS Laboratory with a known amount of each contaminant and the resulting recoveries ranged from 72 percent for 2,4,6-TNT and tetryl to 84 percent for 2,4-DNT. While spike recoveries for two of the compounds analyzed were slightly less than the acceptable range, no data should be qualified based on this information alone.

4.1.2.12 Lot OYZ

Within Lot OYZ, one matrix spike sample, WP2110MS, was analyzed for nitrocellulose. The spike recovery was 80 percent, which is within the acceptable range of 75 to 125 percent.

4.1.2.13 Lots OZB and OZX

Lots of OZB and OZX also consisted of wipe samples analyzed for explosives. Within Lot OZX, wipe sample WP2101MS was spiked with known concentrations of all explosive parameters. The resulting spike recoveries ranged from 88 to 101 percent, which are within the acceptable range.

Wipe sample WP2807MS was spiked with the following explosive compounds and analyzed within Lot OZB: nitrobenzene, 1,3,5-TNB, 2,4-DNT, and 2,4,6-TNT. The resulting spike recoveries ranged from 101 to 105 percent, which are within the acceptable range.

4.1.2.14 Lots PAC and PAI

Within wipe sample Lot PAC matrix spike analyses were conducted on samples WP1704MS and WP2305MS. The resulting spike recoveries ranged from 29 to 31 percent for sample WP1704MS and 50 to 58 percent for sample WP2305MS. The explosives data for samples WP1501, WP1503, WP1503R, WP1506, WP1605, WP1704, WP1704MS, WP2005, WP2105, WP2205, WP2305MS, WP2308, WP2310, WP2404, WP2405, WP2407, WP2501, WP2501R, WP2503, WP2612MS, WP3003 and WP3301 within Lot PAC should be considered to be biased low due to the low matrix spike sample recoveries for samples WP1704MS and WP2305MS.

Wipe samples WP2612MS and WP1909MS were the matrix spike samples for Lot PAI. The spike recoveries for the explosives compounds analyzed ranged from 98 to 100 percent for WP2612MS and 98 to 103 percent for WP1909MS, which are within the acceptable range.

4.1.2.15 Lots PAD and PAJ

Within Lot PAD, matrix spike samples WP1704MS, WP2305MS, and WP2612MS were spiked with nitrocellulose. The resulting recoveries were 69 percent, 72 percent, and 69 percent, respectively. While these spike recoveries are slightly less than the acceptable range, no data should be qualified based on this information alone.

Samples WP1609MS and WP1909MS were spiked with nitrocellulose to determine the spike recoveries for Lot PAJ. The resulting recoveries were 78 and 110 percent, respectively, which are within the acceptable range.

4.1.3 COMPLETENESS

Completeness is defined as the ratio of the number of valid sample results to the total number of samples analyzed with a specific method or of a specific matrix. Completeness of the overall data set may be calculated as follows:

$$C = (V/T) \times 100$$

Where, C = Percent complete,
V = number of measurements judged valid, and
T = total number of measurements.

In accordance with the QCP, the data produced by the CLASS Laboratory was required to have a completeness of greater than or equal to 95% for both soil and water matrices. Data were judged to be complete if reported by IRDMIS at Level 3, with the exception of the data reported for 1,3,5-TNB in Lot ORT, as discussed above in Section 4.1.2.3, which were reported but were qualified to be unusable based on QA/QC criteria.

For the soils matrix, the analytical data for BETX and TRPH are 100% complete, while the analytical data for all nitroaromatics except 1,3,5-TNB, and lead and mercury, are 99.5% complete. These values exceed the QCP's 95% completeness goal. However, the analytical data for 1,3,5-TNB are only 93% complete. Only 67% (18 of 27) of the 1,3,5-TNB analytical results for the ground disturbance samples were usable, while none of the four samples from the debris pile were usable, due to a low spike recovery in Lot ORT as discussed above in Section 4.1.2.3. Analytical data for nitrocellulose are only 92% complete, primarily due to receipt of only 145 out of 161 (90%) igloo results. Although loading ramp data for all analytes are only 94% complete, analytical results are reported for 15 (n-1) of the 16 (n) samples. No information is available from either IRDMIS Level 3 or from the CLASS Laboratory's Quality Assurance Status Reports to explain the absence of this data. However, lack of this data does not compromise the validity of the findings of this investigation.

Although the analytical data for the surface water matrix are 94% complete, just below the QCP's 95% completeness criteria, analytical results are reported for 17 (n-1) of the 18 (n) samples. The pond and background wetland pond analytical data are 100% complete. Although stream sample analytical data are only 92% complete, analytical results are reported for 11 (n-1) of the 12 (n) samples. No information is available from either IRDMIS Level 3 or from the CLASS Laboratory's Quality Assurance Status Reports to explain the absence of data from SW10MS. However, lack of this data does not compromise the validity of the findings of this investigation.

Although the analytical data for the sediment matrix are 94% complete, just below the QCP's 95% completeness criteria, analytical results are reported for 17 (n-1) of the 18 (n) samples. The pond and background wetland pond analytical data are 100% complete. Although the stream sample analytical data are only 92% complete, analytical results are reported for 11 (n-1) of the 12 (n) samples. No information is available from either IRDMIS Level 3 or from the CLASS Laboratory's Quality Assurance Status Reports to explain the absence of data from SE10MS. However, lack of this data does not compromise the validity of the findings of this investigation.

All analytical data are greater than or equal to 95% complete for the building interior surfaces (wipe samples) matrix, and 100% complete for the building interior air (radon samples) matrix.

4.1.4 DATA MANAGEMENT AND REPORTING

Within the QCP, the EI Contractor is tasked to conduct a review of all data resulting from the analysis of the Coosa River EI. The USATHAMA contract with the CLASS Laboratory, however, requires that the Laboratory Quality Assurance Coordinator check the data to ensure that it has been analyzed in accordance with USATHAMA-approved methodologies. The data is then input to IRDMIS for acceptance.

The only QA/QC information required to be submitted by the CLASS Laboratory is the Quality Assurance Status Reports. The EI Contractor Quality Assurance Coordinator received these reports; however, there was not enough information contained within these reports to completely assess the data set and perform a data review and validation to meet the requirements specified in the QCP.

Information obtained from the laboratory's Quality Assurance Status Reports was evaluated as discussed previously and used to qualify the data in accordance with U.S. EPA guidance for data review and validation, which are the generally accepted data qualifiers for universal understanding.

4.1.5 QA/QC REVIEW SUMMARY

As described above, the number of outliers for the replicate analysis of samples for nitrocellulose were greater than for the other parameters analyzed. As a result, the nitrocellulose data should be considered to be less precise.

It should also be noted that the majority of outliers occurred for the analyses of soil and wipe samples. This phenomenon is consistent with expected outcomes since matrix interferences are expected to be greatest for the soil and wipe sample matrices.

Lead, mercury, and nitrocellulose for samples SS1607 and SS1607R were all outliers for the replicate analyses. Results for all parameters for samples SS1607 and SS1607R should be considered to be "estimated" due to these variabilities.

The analytical result for nitrocellulose in SS3405D was reported as biased low due to a low spike recovery for Lot OPK. Results for this sample were reported to be 258 ug/g.

The analytical results for nitrocellulose in samples SS2806, SS2807MS, and SS2808 should be considered as less than the detection limit since the blanks contained a value near that reported for these samples in Lot OUF.

All analytical results for 1,3,5-TNB for samples for the debris pile (SSDP01 through SSDP04), SSGD07A and SSGD07B, SSGD12A and SSGD12B, SSGD14A and SSGD14B, and SSGD15A and SSGD15B were unusable due to low spike recovery in Lot ORT.

All analytical results for nitrocellulose for samples WP1807, WP1903, WP2007, WP2008, WP2009, WP2010, WP2307, WP2502, WP2603, WP2604, WP2606, WP2608, WP2609, WP2620, WP2613, WP23106, WP2807MS and WP3106R within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS.

All analytical results for nitroaromatics/explosives for samples WP1501, WP1503, WP1503R, WP1506, WP1605, WP1704, WP1704MS, WP2005, WP2105, WP2205, WP2305MS, WP2308, WP2310, WP2404, WP2405, WP2407, WP2501, WP2501R, WP2503, WP2612MS, WP3003 and WP3301 within Lot PAC should be considered to be biased low due to the low matrix spike sample recoveries for samples WP1704MS and WP2305MS.

Table 4-1 presents the data qualifier (and other) flagging codes used in IRDMIS and throughout this report.

4.2 BACKGROUND CONCENTRATIONS IN MEDIA

4.2.1 SOIL

Three background soil samples -- SSBG01, SSBG02, and SSBG03 -- were collected at the Annex, all within the "buffer zone" outside of the igloo storage area's fenceline. All background soil samples were analyzed for the following analytical parameters: (1) the metals lead (Pb) and mercury (Hg); (2) nitrocellulose (NC); (3) nitroaromatics/explosives, consisting of 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2,4,6-trinitrotoluene (2,4,6-TNT), nitrobenzene (NB), 1,3-dinitrobenzene (1,3-DNB), 1,3,5-trinitrobenzene (1,3,5-TNB), and tetryl; (4) BETX, consisting of the analytes benzene, ethylbenzene, toluene, and xylenes; and (5) TRPH, total recoverable petroleum hydrocarbons (abbreviated in IRDMIS as TPHC). This suite of analytical parameters corresponds to the complete universe of analytes for all soil samples collected during this EI.

Pb and NC were detected in the background soil samples. Concentrations of Pb in the background samples range from 12 to 18 ug/g. Concentrations of NC range from not detected

(at a detection limit of 23.1 ug/g) to 155 ug/g. Concentrations of all other analytes were below detection limits.

Concentrations of these detected analytes are presented along with analytes detected in other soil samples on Figure 4-2, showing only the highest concentration of an analyte detected at the sample station. Full analytical results for all soil samples are presented in Appendix G. The following paragraphs present a discussion of analytical results on a sample-location-specific basis. For ease of reference, this background information is also presented in later subsections.

Background Soil Station 1

The soil sample from Background Soil Station 1, SSBG01, displayed a detectable concentration of Pb at 13 ug/g. Concentrations of all other analytes in SSBG01 were below detection limits.

Background Soil Station 2

The soil sample from Background Soil Station 2, SSBG02, displayed a detectable concentration of Pb at 18 ug/g. Concentrations of all other analytes in SSBG02 were below detection limits.

Background Soil Station 3

The soil sample from Background Soil Station 3, SSBG03, displayed detectable concentrations of Pb and NC at 12 ug/g and 155 ug/g, respectively. Concentrations of all other analytes in SSBG03 were below detection limits.

4.2.2 WETLAND POND

4.2.2.1 Surface Water

The single wetland pond background surface water sample, SWBG11, was analyzed for the same analytical parameters as the sediment sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl. This suite of analytical parameters corresponds to the complete universe of analytes for all pond sediment samples collected during this EI.

The surface water sample from the background wetland pond, SWBG11, displayed a detectable concentration of NC at 431 ug/g. Concentrations of all other analytes in sample SWBG11 were below detection limits.

Concentrations of detected analytes are presented along with analytes detected in other surface water samples on Figure 4-3, showing only the highest concentration of an analyte detected at the sample station. For ease of reference, this background information is also presented in later subsections.

4.2.2.2 Sediment

The single wetland pond background sediment sample, SEBG11, was analyzed for the same analytical parameters as the surface water sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl. This suite of analytical parameters corresponds to the complete universe of analytes for all pond sediment samples collected during this EI.

The sediment sample from the background wetland pond, SEBG11, displayed detectable concentrations of Pb and NC at concentrations of 22 ug/g and 150 ug/g, respectively. Concentrations of all other analytes in sample SEBG11 were below detection limits.

Concentrations of these detected analytes are presented along with analytes detected in other sediment samples on Figure 4-3, showing only the highest concentration of an analyte detected at the sample station. For ease of reference, this background information is also presented in later subsections.

43 STORAGE IGLOOS

4.3.1 RADIOLOGICAL BUILDING INTERIOR

Radon gas sampling was conducted via alpha track radon detectors placed in 14 of the 136 igloos at the Annex. Igloos monitored for radon gas include 2902, 2903, 2905, 2906, 2908, 2909, 2910, 3005, 3006, 3007, 3008, 3009, 3010, and 3011. Radon was detected in all 14 igloos in which it was monitored for, at a concentration range of 1.0 R to 12.7 R pCi/L.

Radon concentrations are presented on Figure 4-1, showing only the highest concentration of an analyte detected at the sample station. Table 6-4 presents a summary of chemicals detected in building interiors. Full analytical results for all radon samples are presented in Appendix C.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Igloo 2902

The radon sample collected from Igloo 2902, RD2902, displayed a detectable radon concentration as determined by gross alpha count at 8.80 R pCi/L.

Igloo 2903

The radon sample collected from Igloo 2903, RD2903, displayed a detectable radon concentration as determined by gross alpha count at 1.80 R pCi/L.

Igloo 2905

Both an investigative (RD2905) and field replicate sample (RD2905R) were collected at this location. Both samples displayed a detectable radon concentration as determined by gross alpha count at 7.60 R pCi/L and 5.80 R pCi/L, respectively.

Igloo 2906

The radon sample collected from Igloo 2906, RD2906, displayed a detectable radon concentration as determined by gross alpha count at 3.30 R pCi/L.

Igloo 2908

The radon sample collected from Igloo 2908, RD2908, displayed a detectable radon concentration as determined by gross alpha count at 3.50 R pCi/L.

Igloo 2909

Both an investigative (RD2909) and field replicate sample (RD2909R) were collected at this location. Both samples displayed a detectable radon concentration as determined by gross alpha count at 8.80 R pCi/L and 7.60 R pCi/L, respectively.

Igloo 2910

The radon sample collected from Igloo 2910, RD2910, displayed a detectable radon concentration as determined by gross alpha count at 5.40 R pCi/L.

Igloo 3005

The radon sample collected from Igloo 3005, RD3005, displayed a radon concentration determined by gross alpha count of 5.70 R pCi/L.

Igloo 3006

The radon sample collected from Igloo 3006, RD3006, displayed a detectable radon concentration as determined by gross alpha count at 7.60 R pCi/L.

Igloo 3007

The radon sample collected from Igloo 3007, RD3007, displayed a detectable radon concentration as determined by gross alpha count at 8.90 R pCi/L.

Igloo 3008

The radon sample collected from Igloo 3008, RD3008, displayed a detectable radon concentration as determined by gross alpha count at 1.00 R pCi/L.

Igloo 3009

The radon sample collected from Igloo 3009, RD3009, displayed a detectable radon concentration as determined by gross alpha count at 5.60 R pCi/L.

Igloo 3010

Both an investigative (RD3010) and field replicate sample (RD3010R) were collected at this location. Both samples displayed a detectable radon concentration as determined by gross alpha count at 12.7 R pCi/L and 11.0 R pCi/L, respectively.

Igloo 3011

The radon sample collected from Igloo 3011, RD3011, displayed a detectable radon concentration as determined by gross alpha count at 5.80 R pCi/L.

4.3.2 CHEMICAL BUILDING INTERIOR

Wipe samples of interior surfaces were collected at all but two of the 136 igloos at the Annex; since no key could be located for the locks on Igloos 1901 and 3101, lack of access to the interior of these two igloos prevented collection of a sample from them.

All igloo wipe samples were analyzed for the same baseline suite of analytical parameters: (1) NC; and (2) nitroaromatics/explosives -- consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

The wipe samples from Igloos 1910, 2007, 2904, 3108, 3301, and 3302, in addition to the baseline suite of parameters, were sampled and analyzed for: (1) TRPH (abbreviated in IRDMIS as TPHC); and (2) PCBs, consisting of the PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, and PCB-1260.

NC was detected in all (133/133) wipe samples. Various nitroaromatics/explosives were detected in numerous igloos. In order of highest detection frequency to lowest, with detection frequencies presented in parentheses, they are: 2,4,6-TNT (6/131); NB (2/131); and 1,3,5-TNB (1/131). TRPH/TPHC was detected in all six igloos for which it was sampled and analyzed -- Igloos 1910, 2007, 2904, 3108, 3301, and 3302. PCBs were not detected in any of the six igloos for which they were sampled and analyzed -- Igloos 1910, 2007, 2904, 3108, 3301, and 3302, the same igloos for which TRPH was analyzed for and detected at. Levels of all other analytes were below detection limits.

Analytical results for building interior surface (wipe sample) matrix spike samples, designated in IRDMIS and in this report with an MS suffix, are uncorrected for the spike amount (i.e., include the spike amount). Therefore, although they are presented in the appendices, they are not discussed further herein.

Concentrations of these detected analytes are presented on Figure 4-1, showing only the highest concentration of an analyte detected at the sample station. Table 6-4 presents a summary of chemicals detected in building interiors. Full analytical results for all igloo interior chemical samples are presented in Appendix E.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis. Analytical results are presented in this discussion (and on Figure 4-1 and on Table 6-4) in units of ug in correspondence to IRDMIS reports. However, since the samples were collected over a 400 cm² area, the analytical results should properly be expressed in units of ug/400 cm².

Igloo 1501

The wipe sample from Igloo 1501, WP1501, displayed a detectable level of NC at 23 ug. Levels of all other analytes in WP1501 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 1502

The wipe sample from Igloo 1502, WP1502, displayed a detectable level of NC at 53 ug. Although the sample was submitted for analysis of 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB, and tetryl, no analytical results are available for these analytes.

Igloo 1503

Both an investigative (WP1503) and field replicate sample (WP1503R) were collected at this location. Levels of NC and NB were detected at this location. NC was detected at 31 ug in WP1503, and at 38 D ug in WP1503R. NB was detected at 25.7 V ug in WP1503R, but was below detection limits in WP1503. Levels of all other analytes in WP1503 and WP1503R were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample pair within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 1504

The wipe sample from Igloo 1504, WP1504, displayed a detectable level of NC at 111 ug. Levels of all other analytes in WP1504 were below detection limits.

Igloo 1505

The wipe sample from Igloo 1505, WP1505, displayed a detectable level of NC at 24 ug. Levels of all other analytes in WP1505 were below detection limits.

Igloo 1506

The wipe sample from Igloo 1506, WP1506, displayed a detectable level of NC at 23 ug. Levels of all other analytes in WP1506 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample

within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 1507

The wipe sample from Igloo 1507, WP1507, displayed a detectable level of NC at 110 ug. Levels of all other analytes in WP1507 were below detection limits.

Igloo 1508

The wipe sample from Igloo 1508, WP1508, displayed a detectable level of NC at 42 ug. Levels of all other analytes in WP1508 were below detection limits.

Igloo 1509

The wipe sample from Igloo 1509, WP1509, displayed a detectable level of NC at 196 ug. Levels of all other analytes in WP1509 were below detection limits.

Igloo 1601

The wipe sample from Igloo 1601, WP1601, displayed a detectable level of NC at 80 ug. Levels of all other analytes in WP1601 were below detection limits.

Igloo 1602

The wipe sample from Igloo 1602, WP1602, displayed a detectable level of NC at 74 ug. Levels of all other analytes in WP1602 were below detection limits.

Igloo 1603

The wipe sample from Igloo 1603, WP1603, displayed a detectable level of NC at 49 ug. Levels of all other analytes in WP1603 were below detection limits.

Igloo 1604

The wipe sample from Igloo 1604, WP1604, displayed a detectable level of NC at 54 ug. Levels of all other analytes in WP1604 were below detection limits.

Igloo 1605

The wipe sample from Igloo 1605, WP1605, displayed a detectable level of NC at 15 ug. Levels of all other analytes in WP1605 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 1606

The wipe sample from Igloo 1606, WP1606, displayed a detectable level of NC at 59 ug. Levels of all other analytes in WP1606 were below detection limits.

Igloo 1607

Both an investigative (WP1607) and field replicate sample (WP1607R) were collected at this location. NC was detected at 21 ug in WP1607, and at 77 D ug in WP1607R. Levels of all other analytes in WP1607 and WP1607R were below detection limits. 1,3,5-TNB in WP1607 has a flagging code of G. All non-detected analytes in WP1607R have flagging codes of D.

Igloo 1609

Both an investigative (WP1609) and matrix spike sample (WP1609MS) were collected at this location. Levels of NC and 2,4,6-TNT were detected at this location. NC was detected at 17 ug in WP1609. 2,4,6-TNT was detected at 54.1 V ug in WP1609. Although WP1609MS was submitted for analysis of 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl, no analytical result is available for these analytes. Levels of all other analytes in WP1609 were below detection limits with flagging codes of V.

Igloo 1701

The wipe sample from Igloo 1701, WP1701, displayed a detectable level of NC at 24 ug. Levels of all other analytes in WP1701 were below detection limits.

Igloo 1702

The wipe sample from Igloo 1702, WP1702, displayed a detectable level of NC at 110 ug. Levels of all other analytes in WP1702 were below detection limits.

Igloo 1703

The wipe sample from Igloo 1703, WP1703, displayed a detectable level of NC at 110 ug. Levels of all other analytes in WP1703 were below detection limits.

Igloo 1704

Both an investigative (WP1704) and matrix spike sample (WP1704MS) were collected at this sample location. Levels of NC, 1,3,5-TNB, 2,4,6-TNT, 2,4-DNT and NB were detected at Igloo 1704. NC was detected at 78 ug in WP1704. Levels of all other analytes in WP1704 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample pair within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 1705

The wipe sample from Igloo 1705, WP1705, displayed a detectable level of NC at 110 ug. Levels of all other analytes in WP1705 were below detection limits.

Igloo 1706

Both an investigative (WP1706) and field replicate sample (WP1706R) were collected at this location. NC was detected at 93 ug in WP1706, and at 17 D ug in WP1706R. Levels of all other analytes in WP1706 and WP1706R were below detection limits. All analytes in WP1706R have a D flagging code.

Igloo 1707

The wipe sample from Igloo 1707, WP1707, displayed a detectable level of NC at 22 ug. Levels of all other analytes in WP1707 were below detection limits.

Igloo 1708

The wipe sample from Igloo 1708, WP1708, displayed detectable levels of NC and 2,4,6-TNT at 22 ug and 7.95 V ug, respectively. Levels of all other analytes in WP1708 were below detection limits with flagging codes of V.

Igloo 1709

The wipe sample from Igloo 1709, WP1709, displayed a detectable level of NC at 25 ug. Levels of all other analytes in WP1709 were below detection limits with flagging codes of V.

Igloo 1710

The wipe sample from Igloo 1710, WP1710, displayed detectable levels of NC and 2,4,6-TNT at 18 ug and 11.4 V ug, respectively. Levels of all other analytes in WP1710 were below detection limits with flagging codes of V.

Igloo 1804

The wipe sample from Igloo 1804, WP1804, displayed a detectable level of NC at 69 ug. Levels of all other analytes in WP1804 were below detection limits.

Igloo 1805

Both an investigative (WP1805) and field replicate sample (WP1805R) were collected at this location. NC was detected at 38 ug in WP1805, and at 24 D ug in WP1805R. Levels of all other analytes in WP1805 and WP1805R were below detection limits. All analytes in WP1805R have a D flagging code.

Igloo 1806

The wipe sample from Igloo 1806, WP1806, displayed a detectable level of NC at 37 ug. Levels of all other analytes in WP1806 were below detection limits.

Igloo 1807

The wipe sample from Igloo 1807, WP1807, displayed a detectable level of NC at 66 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP1807 were below detection limits.

Igloo 1808

The wipe sample from Igloo 1808, WP1808, displayed a detectable level of NC at 23 ug. Levels of all other analytes in WP1808 were below detection limits.

Igloo 1809

The wipe sample from Igloo 1809, WP1809, displayed detectable levels of NC and 2,4,6-TNT at 160 ug and 34.2 V ug, respectively. Levels of all other analytes in WP1809 were below detection limits with flagging codes of V.

Igloo 1902

The wipe sample from Igloo 1902, WP1902, displayed detectable levels of NC and NB at 54 ug and 2.57 V ug, respectively. Levels of all other analytes in WP1902 were below detection limits with flagging codes of V.

Igloo 1903

The wipe sample from Igloo 1903, WP1903, displayed a detectable level of NC at 48 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP1903 were below detection limits.

Igloo 1904

The wipe sample from Igloo 1904, WP1904, displayed a detectable level of NC at 27 ug. Although the sample was submitted for analysis of 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl, no analytical results are available for these analytes.

Igloo 1906

Both an investigative (WP1906) and field replicate sample (WP1906R) were collected at this location. NC was detected at 15 ug in WP1906, and at 36 D ug in WP1906R. Levels of all other analytes in WP1906 and WP1906R were below detection limits. All analytes in WP1906R have a flagging code of D.

Igloo 1907

The wipe sample from Igloo 1907, WP1907, displayed detectable levels of NC and 2,4,6-TNT at 29 ug and 10.7 V ug, respectively. Levels of all other analytes in WP1907 were below detection limits with flagging codes of V.

Igloo 1908

The wipe sample from Igloo 1908, WP1908, displayed a detectable level of NC at 24 ug. Levels of all other analytes in WP1908 were below detection limits.

Igloo 1909

Both an investigative (WP1909) and matrix spike sample (WP1909MS) were collected at this location. NC was detected at 35 ug in WP1909 at this location. Levels of all other analytes in WP1909 were below detection limits with flagging codes of V.

Igloo 1910

The wipe sample from Igloo 1910, WP1910, displayed detectable levels of NC and TRPH/TPHC at 110 ug and 1000 ug, respectively. Levels of all other analytes in WP1910, including PCBs, were below detection limits.

Igloo 2001

The wipe sample from Igloo 2001, WP2001, displayed a detectable level of NC at 36 ug. Levels of all other analytes in WP2001 were below detection limits.

Igloo 2002

The wipe sample from Igloo 2002, WP2002, displayed a detectable level of NC at 32 ug. Levels of all other analytes in WP2002 were below detection limits.

Igloo 2003

The wipe sample from Igloo 2003, WP2003, displayed a detectable level of NC at 140 ug. Levels of all other analytes in WP2003 were below detection limits.

Igloo 2004

Both an investigative (WP2004) and field replicate sample (WP2004R) were collected at this location. NC was detected at 42 ug in WP2004, and at 32 D ug in WP2004R. Levels of all other analytes in WP2004 and WP2004R were below detection limits. All analytes in WP2004R have a flagging code of D.

Igloo 2005

The wipe sample from Igloo 2005, WP2005, displayed a detectable level of NC at 48 ug. Levels of all other analytes in WP2005 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2006

The wipe sample from Igloo 2006, WP2006, displayed a detectable level of NC at 18 ug. Levels of all other analytes in WP2006 were below detection limits.

Igloo 2007

The wipe sample from Igloo 2007, WP2007, displayed detectable levels of NC and TRPH/TPHC at 81 ug and 910 ug, respectively. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2007, including PCBs, were below detection limits.

Igloo 2008

The wipe sample from Igloo 2008, WP2008, displayed a detectable level of NC at 77 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2008 were below detection limits.

Igloo 2009

The wipe sample from Igloo 2009, WP2009, displayed a detectable level of NC at 33 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2009 were below detection limits.

Igloo 2010

The wipe sample from Igloo 2010, WP2010, displayed a detectable level of NC at 37 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be

considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2101 were below detection limits.

Igloo 2101

Both an investigative (WP2101) and matrix spike sample (WP2101MS) were collected at this location. NC was detected at 36 ug in WP2101 at this location. Levels of all other analytes in WP2101 were below detection limits.

Igloo 2102

The wipe sample from Igloo 2102, WP2102, displayed a detectable level of NC at 26 ug. Levels of all other analytes in WP2102 were below detection limits.

Igloo 2103

Both an investigative (WP2103) and field replicate sample (WP2103R) were collected at this location. NC was detected at 21 ug in WP2103, and at 18 D ug in WP2103R. Levels of all other analytes in WP2103 and WP2103R were below detection limits. All analytes in WP2103R have flagging codes of D.

Igloo 2104

The wipe sample from Igloo 2104, WP2104, displayed a detectable level of NC as 33 ug. Levels of all other analytes in WP2104 were below detection limits.

Igloo 2105

The wipe sample from Igloo 2105, WP2105, displayed a detectable level of NC at 33 ug. Levels of all other analytes in WP2105 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2108

The wipe sample from Igloo 2108, WP2108, displayed a detectable level of NC at 100 ug. Levels of all other analytes in WP2108 were below detection limits.

Igloo 2201

The wipe sample from Igloo 2201, WP2201, displayed a detectable level of NC at 28 ug. Levels of all other analytes in WP2201 were below detection limits.

Igloo 2202

The wipe sample from Igloo 2202, WP2202, displayed a detectable level of NC at 64 ug. Levels of all other analytes in WP2202 were below detection limits.

Igloo 2203

Both an investigative (WP2203) and field replicate sample (WP2203R) were collected at this location. NC was detected at 18 ug in WP2203, and at 21 D ug in WP2203R. Levels of all other analytes in WP2203 and WP2203R were below detection limits. All analytes in WP2203R have flagging codes of D.

Igloo 2204

The wipe sample from Igloo 2204, WP2204, displayed a detectable level of NC at 40 ug. Levels of all other analytes in WP2204 were below detection limits.

Igloo 2205

The wipe sample from Igloo 2205, WP2205, displayed a detectable level of NC at 53 ug. Levels of all other analytes in WP2205 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2206

The wipe sample from Igloo 2206, WP2206, displayed a detectable level of NC at 36 ug. Although the sample was submitted for analysis of 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl, no analytical results are available for these analytes.

Igloo 2301

The wipe sample from Igloo 2301, WP2301, displayed a detectable level of NC at 20 ug. Levels of all other analytes in WP2301 were below detection limits.

Igloo 2302

The wipe sample from Igloo 2302, WP2302, displayed a detectable level of NC at 35 ug. Levels of all other analytes in WP2302 were below detection limits.

Igloo 2303

The wipe sample from Igloo 2303, WP2303, displayed a detectable level of NC at 32 ug. Levels of all other analytes in WP2303 were below detection limits.

Igloo 2304

Both an investigative (WP2304) and field replicate sample (WP2304R) were collected at this location. NC was detected at 11 ug in WP2304, and at 79 D ug in WP2304R. Levels of all other analytes in WP2304 and WP2304R were below detection limits. All analytes in WP2304R have flagging codes of D.

Igloo 2305

Both an investigative (WP2305) and matrix spike sample (WP2305MS) were collected at this location. NC was detected at 37 ug in WP2305 at this location. Although WP2305 was submitted for analysis of 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl, no analytical results are available for these analytes.

Igloo 2307

The wipe sample from Igloo 2307, WP2307, displayed a detectable level of NC at 71 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2307 were below detection limits.

Igloo 2308

The wipe sample from Igloo 2308, WP2308, displayed a detectable level of NC at 81 ug. Levels of all other analytes in WP2308 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2310

The wipe sample from Igloo 2310, WP2310, displayed a detectable level of NC at 15 ug. Levels of all other analytes in WP2310 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2402

The wipe sample from Igloo 2402, WP2402, displayed a detectable level of NC at 16 ug. Levels of all other analytes in WP2402 were below detection limits. 1,3,5-TNB has a flagging code of G.

Igloo 2403

The wipe sample from Igloo 2403, WP2403, displayed a detectable level of NC at 42 ug. Levels of all other analytes in WP2403 were below detection limits.

Igloo 2404

The wipe sample from Igloo 2404, WP2404, displayed a detectable level of NC at 32 ug. Levels of all other analytes in WP2404 were below detection limits. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2405

The wipe sample from Igloo 2405, WP2405, displayed a detectable level of NC at 82 ug. Levels of all other analytes in WP2405 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2406

The wipe sample from Igloo 2406, WP2406, displayed a detectable level of NC at 25 ug. Levels of all other analytes in WP2406 were below detection limits.

Igloo 2407

The wipe sample from Igloo 2407, WP2407, displayed a detectable level of NC at 32 ug. Levels of all other analytes in WP2407 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2501

Both an investigative (WP2501) and field replicate sample (WP2501R) were collected at this location. NC was detected at levels of 19 ug in WP2501, and at 25 D ug in WP2501R. Levels of all other analytes in WP2501 and WP2501R were below detection limits. All analytes in WP2501 below detection limits have flagging codes of V. All analytes in WP2501R have flagging codes of D. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample pair within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2502

The wipe sample from Igloo 2502, WP2502, displayed a detectable level of NC at 27 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2502 were below detection limits.

Igloo 2503

The wipe sample from Igloo 2503, WP2503, displayed a detectable level of NC at 26 ug. Levels of all other analytes in WP2503 were below detection limits. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 2602

The wipe sample from Igloo 2602, WP2602, displayed a detectable level of NC at 30 ug. Levels of all other analytes in WP2602 were below detection limits.

Igloo 2603

The wipe sample from Igloo 2603, WP2603, displayed a detectable level of NC at 30 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2603 were below detection limits.

Igloo 2604

The wipe sample from Igloo 2604, WP2604, displayed a detectable level of NC at 73 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2604 were below detection limits.

Igloo 2605

Both an investigative (WP2605) and field replicate sample (WP2605R) were collected at this location. Although WP2605 and WP2605R were submitted for analysis of NC, no analytical result is available for this analyte for either sample. Levels of all other analytes in WP2605 and WP2605R were below detection limits. All analytes in WP2605R have flagging codes of D.

Igloo 2606

The wipe sample from Igloo 2606, WP2606, displayed a detectable level of NC at 22 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2606 were below detection limits.

Igloo 2608

The wipe sample from Igloo 2608, WP2608, displayed a detectable level of NC at 85 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2608 were below detection limits.

Igloo 2609

The wipe sample from Igloo 2609, WP2609, displayed a detectable level of NC at 30 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be

considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2609 were below detection limits.

Igloo 2610

The wipe sample from Igloo 2610, WP2610, displayed a detectable level of NC at 30 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2610 were below detection limits.

Igloo 2612

Both an investigative (WP2612) and matrix spike sample (WP2612MS) were collected at this location. NC was detected at 28 ug in WP2612 at this location. Although WP2612 was submitted for analysis of 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB, and tetryl, no analytical results are available for these analytes.

Igloo 2613

The wipe sample from Igloo 2613, WP2613, displayed a detectable level of NC at 45 ug. As discussed previously under Section 4.1.5, NC results for this sample within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP2613 were below detection limits.

Igloo 2701

The wipe sample from Igloo 2701, WP2701, displayed a detectable level of NC at 25 ug. Levels of all other analytes in WP2701 were below detection limits.

Igloo 2702

The wipe sample from Igloo 2702, WP2702, displayed a detectable level of NC at 28 ug. Levels of all other analytes in WP2702 were below detection limits.

Igloo 2703

The wipe sample from Igloo 2703, WP2703, displayed detectable levels of NC and 1,3,5-TNB at 21 ug and 1.84 ug, respectively. Levels of all other analytes in WP2703 were below detection limits.

Igloo 2704

The wipe sample from Igloo 2704, WP2704, displayed a detectable level of NC at 41 ug. Levels of all other analytes in WP2704 were below detection limits.

Igloo 2705

The wipe sample from Igloo 2705, WP2705, displayed a detectable level of NC at 36 ug. Levels of all other analytes in WP2705 were below detection limits.

Igloo 2707

Both an investigative (WP2707) and field replicate sample (WP2707R) were collected at this location. NC was detected at 31 ug in WP2707, and at 28 D ug in WP2707R. Levels of all other analytes in WP2707 and WP2707R were below detection limits. All analytes in WP2707R have flagging codes of D.

Igloo 2708

The wipe sample from Igloo 2708, WP2708, displayed a detectable level of NC at 36 ug. Levels of all other analytes in WP2708 were below detection limits.

Igloo 2710

The wipe sample from Igloo 2710, WP2710, displayed a detectable level of NC at 24 ug. Levels of all other analytes in WP2710 were below detection limits.

Igloo 2711

The wipe sample from Igloo 2711, WP2711, displayed a detectable levels of NC at 28 ug. Levels of all other analytes in WP2711 were below detection limits.

Igloo 2801

The wipe sample from Igloo 2801, WP2801, displayed a detectable level of NC at 40 ug. Levels of all other analytes in WP2801 were below detection limits.

Igloo 2802

The wipe sample from Igloo 2802, WP2802, displayed a detectable level of NC at 36 ug. Levels of all other analytes in WP2802 were below detection limits.

Igloo 2803

The wipe sample from Igloo 2803, WP2803, displayed a detectable level of NC at 31 ug. Levels of all other analytes in WP2803 were below detection limits.

Igloo 2804

Both an investigative (WP2804) and field replicate sample (WP2804R) were collected at this location. NC was detected at 33 ug in WP2804, and at 34 D ug in WP2804R. Levels of all other analytes in WP2804 and WP2804R were below detection limits. All analytes in WP2804R have flagging codes of D.

Igloo 2806

The wipe sample from Igloo 2806, WP2806, displayed a detectable level of NC at 40 ug. Levels of all other analytes in WP2806 were below detection limits.

Igloo 2807

Both an investigative (WP2807) and matrix spike sample (WP2807MS) were collected at this location. NC was detected at 58 ug in WP2807 at this location. Levels of all other analytes in WP2807 were below detection limits.

Igloo 2808

The wipe sample from Igloo 2808, WP2808, displayed a detectable level of NC at 46 ug. Levels of all other analytes in WP2808 were below detection limits.

Igloo 2809

The wipe sample from Igloo 2809, WP2809, displayed a detectable level of NC at 32 ug. Levels of all other analytes in WP2809 were below detection limits.

Igloo 2810

The wipe sample from Igloo 2810, WP2810, displayed a detectable level of NC at 23 ug. Levels of all other analytes in WP2810 were below detection limits.

Igloo 2901

The wipe sample from Igloo 2901, WP2901, displayed a detectable level of NC at 62 ug. Levels of all other analytes in WP2901 were below detection limits.

Igloo 2902

The wipe sample from Igloo 2902, WP2902, displayed a detectable level of NC at 100 ug. Levels of all other analytes in WP2902 were below detection limits.

Igloo 2903

The wipe sample from Igloo 2903, WP2903, displayed a detectable level of NC at 31 ug. Levels of all other analytes in WP2903 were below detection limits.

Igloo 2904

The wipe sample from Igloo 2904, WP2904, displayed detectable levels of NC and TRPH/TPHC at 19 ug and 510 ug, respectively. Levels of all other analytes in WP2904, including PCBs, were below detection limits. 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl have flagging codes of V.

Igloo 2905

Both an investigative (WP2905) and field replicate sample (WP2905R) were collected at this location. NC was detected at 69 ug in WP2905, and at 21 D ug in WP2905R. Levels of all other analytes in WP2905 and WP2905R were below detection limits. All analytes in WP2905R have flagging codes of D.

Igloo 2906

The wipe sample from Igloo 2906, WP2906, displayed a detectable level of NC at 26 ug. Levels of all other analytes in WP2906 were below detection limits.

Igloo 2908

The wipe sample from Igloo 2908, WP2908, displayed a detectable level of NC at 25 ug. Levels of all other analytes in WP2908 were below detection limits.

Igloo 2909

Both an investigative (WP2909) and field replicate sample (WP2909R) were collected at this location. NC was detected at 26 ug in WP2909, and at 36 D ug in WP2909R. Levels of all other analytes in WP2909 and WP2909R were below detection limits. All analytes in WP2909R have flagging codes of D.

Igloo 2910

The wipe sample from Igloo 2910, WP2910, displayed a detectable level of NC at 39 ug. Levels of all other analytes in WP2910 were below detection limits.

Igloo 3001

The wipe sample from Igloo 3001, WP3001, displayed a detectable level of NC at 62 ug. Levels of all other analytes in WP3001 were below detection limits with flagging codes of V.

Igloo 3002

The wipe sample from Igloo 3002, WP3002, displayed a detectable level of NC at 61 ug. Levels of all other analytes in WP3002 were below detection limits.

Igloo 3003

The wipe sample from Igloo 3003, WP3003, displayed detectable levels of NC and 2,4,6-TNT at 34 ug and 15.5 V ug, respectively. Levels of all other analytes in WP3003 were below detection limits with flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 3005

The wipe sample from Igloo 3005, WP3005, displayed a detectable level of NC at 29 ug. Levels of all other analytes in WP3005 were below detection limits.

Igloo 3006

The wipe sample from Igloo 3006, WP3006, displayed a detectable level of NC at 14 ug. Levels of all other analytes in WP3006 were below detection limits.

Igloo 3007

The wipe sample from Igloo 3007, WP3007, displayed detectable levels of NC at 22 ug. Levels of all other analytes in WP3007 were below detection limits.

Igloo 3008

The wipe sample from Igloo 3008, WP3008, displayed a detectable level of NC at 19 ug. Levels of all other analytes in WP3008 were below detection limits.

Igloo 3009

The wipe sample from Igloo 3009, WP3009, displayed a detectable level of NC at 73 ug. Levels of all other analytes in WP3009 were below detection limits.

Igloo 3010

Both an investigative (WP3010) and field replicate sample (WP3010R) were collected at this location. NC was detected at 59 ug in WP3010, and at 29 D ug in WP3010R. Levels of all other analytes in WP3010 and WP3010R were below detection limits. All analytes in WP3010R have flagging codes of D.

Igloo 3011

The wipe sample from Igloo 3011, WP3011, displayed a detectable level of NC at 86 ug. Levels of all other analytes in WP3011 were below detection limits.

Igloo 3102

The wipe sample from Igloo 3102, WP3102, displayed a detectable level of NC at 90 ug. Levels of all other analytes in WP3102 were below detection limits.

Igloo 3106

Both an investigative (WP3106) and field replicate sample (WP3106R) were collected at this location. NC was detected at 22 ug in WP3106, and at 140 D ug in WP3106R. As discussed previously under Section 4.1.5, NC results for this sample pair within Lot OZW should be considered to be biased low due to the low matrix spike recovery for sample WP2807MS. Levels of all other analytes in WP3106 and WP3106R were below detection limits. All analytes in WP3106R have flagging codes of D.

Igloo 3107

The wipe sample from Igloo 3107, WP3107, displayed a detectable level of NC at 110 ug. Levels of all other analytes in WP3107 were below detection limits.

Igloo 3108

Both an investigative (WP3108) and matrix spike sample (WP3108MS) were collected at this location. Levels of NC and TRPH/TPHC were detected at 100 ug and 100 ug, respectively, in WP3108 at this location. Levels of all other analytes in WP3108, including PCBs, were below detection limits.

Igloo 3110

The wipe sample from Igloo 3110, WP3110, displayed a detectable level of NC at 93 ug. Levels of all other analytes in WP3110 were below detection limits.

Igloo 3301

The wipe sample from Igloo 3301, WP3301, displayed detectable levels of NC and TRPH/TPHC at 130 ug and 370 ug, respectively. Levels of all other analytes in WP3301, including PCBs, were below detection limits. 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl have flagging codes of V. As discussed previously under Section 4.1.5, nitroaromatics/explosives results for this sample within Lot PAC should be considered to be biased low due to the low matrix spike recoveries for samples WP1704MS and WP2305MS.

Igloo 3302

The wipe sample from Igloo 3302, WP3302, displayed detectable levels of NC and TRPH/TPHC at 30 ug and 330 ug, respectively. Levels of all other analytes in WP3302,

including PCBs, were below detection limits. 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl have flagging codes of V.

4.3.3 SOIL

Surficial soil samples collected from the areas around the entrances to the igloos, in the areas of the floor drainage channel grates, were analyzed for the same baseline suite of analytical parameters: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

The soil samples from Igloo 1607, SS1607 and SS1607R, in addition to the baseline suite of parameters, were analyzed for: (1) BETX, consisting of the analytes benzene, ethylbenzene, toluene and xylenes; and (2) TRPH (abbreviated in IRDMIS as TPHC). While concentrations of BETX analytes were all below the detection limits in both SS1607 and SS1607R, both samples displayed detectable concentrations of TRPH/TPHC. However, as discussed above under Section 4.1.5, results for all parameters in samples SS1607 and SS1607R should be considered to be estimated due to outliers for replicate analytical results for Pb, Hg and NC.

Pb, Hg, and NC were detected in numerous samples, from 135, 57 and 56 igloos, respectively. Other compounds detected above background are 2,4-DNT, and 2,6-DNT. These compounds were detected in samples from five and one igloos, respectively.

Concentrations of these detected analytes are presented along with analytes detected in other soil samples on Figure 4-2, showing only the highest concentration of an analyte detected at the sample station. Table 6-2 presents a summary of chemicals detected in soil. Full analytical results for all soil samples are presented in Appendix G.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Background Soil Concentrations

As discussed above under Section 4.2.1, Pb and NC were detected in the background soil samples. Concentrations of Pb in the background samples range from 12 to 18 ug/g. Concentrations of NC range from not detected (at a detection limit of 23.1 ug/g) to 155 ug/g. Concentrations of all other analytes, including BETX and TRPH/TPHC, were below detection limits.

Igloo 1501

The soil sample from Igloo 1501, SS1501, displayed detectable concentrations of Pb and Hg at 310 ug/g and 0.0642 ug/g, respectively. Both these concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1501 were below detection limits.

Igloo 1502

The soil sample from Igloo 1502, SS1502, displayed detectable concentrations of Pb, Hg, and NC at 390 ug/g, 0.0653 ug/g, and 55.5 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within the background range. Concentrations of all other analytes in SS1502 were below detection limits.

Igloo 1503

Both an investigative (SS1503) and field replicate sample (SS1503R) were collected at this sample location. Concentrations of Pb and NC were detected at Igloo 1503. Pb was detected at 120 ug/g in SS1503, and at 110 D ug/g in SS1503R. NC was detected at 56.9 ug/g in SS1503, but was below the detection limit in SS1503R. The Pb concentrations are above the background concentration range, while the NC concentration is within the background range. Concentrations of all other analytes in SS1503 and SS1503R were below detection limits. All analytes in SS1503R have flagging codes of D.

Igloo 1504

The soil sample from Igloo 1504, SS1504, displayed detectable concentrations of Pb and Hg at 33 ug/g and 0.0699 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1504 were below detection limits.

Igloo 1505

The soil sample from Igloo 1505, SS1505, displayed detectable concentrations of Pb and Hg at 81 ug/g and 0.0895 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1505 were below detection limits.

Igloo 1506

The soil sample from Igloo 1506, SS1506, displayed a detectable concentration of Pb at 31 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1506 were below detection limits.

Igloo 1507

The soil sample from Igloo 1507, SS1507, displayed a detectable concentration of Pb at 21 ug/g. This concentration is marginally above the background concentration range. Concentrations of all other analytes in 1507 were below detection limits.

Igloo 1508

The soil sample from Igloo 1508, SS1508, displayed detectable concentrations of Pb and Hg at 71 ug/g and 0.0689 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1508 were below detection limits.

Igloo 1509

The soil sample from Igloo 1509, SS1509, displayed a detectable concentration of Pb at 33 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1509 were below detection limits.

Igloo 1601

The soil sample from Igloo 1601, SS1601, displayed detectable concentrations of Pb and NC at 270 ug/g and 92.1 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. The other analytes in SS1601 were below detection limits.

Igloo 1602

The soil sample from Igloo 1602, SS1602, displayed detectable concentrations of Pb and Hg at 88 ug/g and 0.0659 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1602 were below detection limits.

Igloo 1603

The soil sample from Igloo 1603, SS1603, displayed detectable concentrations of Pb and Hg at 27 ug/g and 0.0663 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1603 were below detection limits.

Igloo 1604

The soil sample from Igloo 1604, SS1604, displayed detectable concentrations of Pb and NC at 260 ug/g and 88.9 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS 1604 were below detection limits.

Igloo 1605

The soil sample from Igloo 1605, SS1605, displayed detectable concentrations of Pb and Hg at 68 ug/g and 0.0664 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1605 were below detection limits.

Igloo 1606

The soil sample from Igloo 1606, SS1606, displayed detectable concentrations of Pb, Hg, and NC at 180 ug/g, 0.0847 ug/g, and 48.4 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS1606 were below detection limits.

Igloo 1607

Both an investigative (SS1607) and field replicate sample (SS1607R) were collected at this sample location. Pb was detected in both samples at concentrations of 51 ug/g and 120 D ug/g, respectively. Hg and NC were detected in SS1607, but were below detection limits in SS1607R. Hg in SS1607 was 0.0880 ug/g; NC in SS1607 was 49.8 ug/g. Both SS1607 and its field replicate SS1607R displayed detectable concentrations of TRPH/TPHC at 21.2 ug/g and 11.8 D ug/g, respectively. The detected Pb, Hg and TRPH/TPHC concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes, including BETX, in both SS1607 and SS1607R were below detection limits. All analytes in SS1607R have flagging codes of D.

However, as discussed above under Section 4.1.5, results for all parameters in these samples should be considered to be estimated due to outliers for replicate analytical results for Pb, Hg and NC.

Igloo 1609

Both an investigative (SS1609) and matrix spike sample (SS1609MS) were collected at this sample location. However, it appears that the analytical laboratory analyzed the MS sample as a field replicate sample rather than as a matrix spike sample. Pb and NC were detected at this location. Pb was detected in sample SS1609 at 32 ug/g, and in SS1609MS at 66 D ug/g. NC was detected in sample SS1609MS at 40.4 D ug/g, but was below the detection limit in SS1609. The Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentrations are within its background range. Concentrations of all other analytes in both SS1609 and SS1609MS were below detection limits. All analytes in SS1609MS have flagging codes of D.

Igloo 1701

The soil sample from Igloo 1701, SS1701, displayed a detectable concentration of Pb at 64 ug/g. This concentration is above its respective background concentration range. Concentrations of all other analytes in SS1701 were below detection limits.

Igloo 1702

The soil sample from Igloo 1702, SS1702, displayed detectable concentrations of Pb, NC, 2,4-DNT and 2,6-DNT at 90 ug/g, 125 ug/g, 500 ug/g, and 32 ug/g, respectively. These concentrations are all above their respective background concentration ranges. Concentrations of all other analytes in SS1702 were below detection limits.

Igloo 1703

The soil sample from Igloo 1703, SS1703, displayed detectable concentrations of Pb and Hg at 160 ug/g and 0.0657 ug/g, respectively. These concentrations are both above their respective background concentration ranges. Concentrations of all other analytes in SS1703 were below detection limits.

Igloo 1704

Both an investigative (SS1704) and matrix spike sample (SS1704MS) were collected at this sample location. However, it appears that the analytical laboratory analyzed the MS sample as

a field replicate sample rather than as a matrix spike sample. Pb was detected at this location at a concentration of 49 ug/g in SS1704 and at 250 D ug/g in SS1704MS. These concentration are above the background concentration range. Concentrations of all other analytes in both SS1704 and SS1704MS were below detection limits. All analytes in SS1704MS have flagging codes of D.

Igloo 1705

The soil sample from Igloo 1705, SS1705, displayed a detectable concentration of Pb at 99 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1705 were below detection limits.

Igloo 1706

Both an investigative (SS1706) and a field replicate sample (SS1706R) were collected at this sample location. Concentrations of Pb, Hg and NC were detected at this location. Pb was detected at 41 ug/g in SS1706 and at 180 D ug/g in SS1706R. Hg was detected at a concentration of 0.0657 ug/g in SS1706 and at 0.0666 D ug/g in SS1706R. NC was detected at 47.5 ug/g in SS1706, but was below the detection limit in SS1706R. The Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentrations are within its background range. Concentrations of all other analytes in both SS1706 and SS1706R were below detection limits. All analytes in SS1706R have flagging codes of D.

Igloo 1707

The soil sample from Igloo 1707, SS1707, displayed detectable concentrations of Pb and NC at 140 ug/g and 43.5 ug/g, respectively. Hg was analyzed for twice in SS1707; in one analysis it was detected at a concentration of 0.0675 ug/g, while in the second analysis it was below the detection limit. Both of the Pb concentrations, and the detected Hg concentration, are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS1707 were below detection limits.

Igloo 1708

The soil sample from Igloo 1708, SS1708, displayed a detectable concentration of Pb at 60 ug/g. This concentration is above the background concentration range. Although the sample was submitted for analysis of Hg, no analytical result is available for this analyte. Concentrations of all other analytes in SS1708 were below detection limits.

Igloo 1709

The soil sample from Igloo 1709, SS1709, displayed a detectable concentration of Pb at 32 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1709 were below detection limits.

Igloo 1710

The soil sample from Igloo 1710, SS1710, displayed a detectable concentration of Pb at 50 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1710 were below detection limits.

Igloo 1804

The soil sample from Igloo 1804, SS1804, displayed detectable concentrations of Pb and Hg at 51 ug/g and 0.0154 ug/g, respectively. These concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS1710 were below detection limits.

Igloo 1805

Both an investigative (SS1805) and a field replicate sample (SS1805R) were collected at this sample location. Pb, NC and 2,4-DNT were detected at this location. Pb was detected at 320 ug/g in SS1805 and at 250 D ug/g in SS1805R. NC was detected at 183 D ug/g in SS1805R, but was below the detection limit in SS1805. 2,4-DNT was detected at 5.65 D ug/g in SS1805R, but was below the detection limit in SS1805. The Pb concentrations are above its background concentration range, while the NC concentrations are within its background range and the detected 2,4-DNT concentration is above the background value (non-detected). Concentrations of all other analytes in both SS1805 and SS1805R were below detection limits. All analytes in SS1805R have flagging codes of D.

Igloo 1806

The soil sample from Igloo 1806, SS1806, displayed detectable concentrations of Pb and NC at 240 ug/g and 38.3 ug/g, respectively. Concentrations of all other analytes in SS1806 were below detection limits.

Igloo 1807

The soil sample from Igloo 1807, SS1807, displayed a detectable concentration of Pb at 43 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1807 were below detection limits.

Igloo 1808

The soil sample from Igloo 1808, SS1808, displayed detectable concentrations of Pb and NC at 130 ug/g and 40.4 ug/g, respectively. The Pb concentration is above its respective background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS1808 were below detection limits.

Igloo 1809

The soil sample from Igloo 1809, SS1809, displayed detectable concentrations of Pb and NC at 86 ug/g and 52.1 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS1809 were below detection limits.

Igloo 1901

The soil sample from Igloo 1901, SS1901, displayed detectable concentrations of Pb and NC at 280 ug/g and 122 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS1901 were below detection limits.

Igloo 1902

The soil sample from Igloo 1902, SS1902, displayed a detectable concentration of Pb at 77 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1902 were below detection limits.

Igloo 1903

The soil sample from Igloo 1903, SS1903, displayed detectable concentrations of Pb and NC at 66 ug/g and 49.1 ug/g, respectively. The Pb concentration is above its respective background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS1903 were below detection limits.

Igloo 1904

The soil sample from Igloo 1904, SS1904, displayed detectable concentrations of Pb and NC at 91 ug/g and 44.7 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS1904 were below detection limits.

Igloo 1906

Both an investigative (SS1906) and a field replicate sample (SS1906R) were collected at this sample location. Concentrations of Pb and NC were detected at this location. Pb was detected at 200 ug/g in SS1906 and at 94 D ug/g in SS1906R. NC was detected at concentrations of 42.7 ug/g in SS1906 and at 2,500 D ug/g in SS1906R. Both Pb concentrations are above its background concentration range, while only the higher NC concentration is above its background range. Concentrations of all other analytes in both SS1906 and SS1906R were below detection limits. All analytes in SS1906R have flagging codes of D.

Igloo 1907

The soil sample from Igloo 1907, SS1907, displayed detectable concentrations of Pb and NC at 100 ug/g and 84.7 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS1907 were below detection limits.

Igloo 1908

The soil sample from Igloo 1908, SS1908, displayed detectable concentrations of Pb and NC at 52 ug/g and 60.1 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS1908 were below detection limits.

Igloo 1909

Both an investigative (SS1909) and matrix spike sample (SS1909MS) were collected at this location. However, it appears that the analytical laboratory analyzed the MS sample as a field replicate sample rather than as a matrix spike sample. Concentrations of Pb and NC were detected at this location. Pb was detected at 48 ug/g in SS1909 and at 42 D ug/g in SS1909MS. NC was detected at 55.8 ug/g in SS1909 and at 76.8 D ug/g in SS1909MS. Both Pb concentrations are above its background concentration range, while both NC

concentrations are within its background range. Concentrations of all other analytes in both SS1909 and SS1909MS were below detection limits. All analytes in SS1909MS have flagging codes of D.

Igloo 1910

The soil sample from Igloo 1910, SS1910, displayed a detectable concentration of Pb at 55 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS1910 were below detection limits.

Igloo 2001

The soil sample from Igloo 2001, SS2001, displayed detectable concentrations of Pb, Hg and NC at 120 ug/g, 0.0699 ug/g, and 73.5 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2001 were below detection limits.

Igloo 2002

The soil sample from Igloo 2002, SS2002, displayed detectable concentrations of Pb and Hg at 130 ug/g and 0.0689 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2002 were below detection limits.

Igloo 2003

The soil sample from Igloo 2003, SS2003, displayed detectable concentrations of Pb and NC at 65 ug/g and 105 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS2003 were below detection limits.

Igloo 2004

Both an investigative (SS2004) and a field replicate sample (SS2004R) were collected at this location. Pb was detected at this location at a concentration of 90 ug/g in SS2004 and at 74 D ug/g in SS2004R. These concentrations are both above the background concentration range. Concentrations of all other analytes in SS2004 were below detection limits. All analytes in SS2004R have flagging codes of D.

Igloo 2005

The soil sample from Igloo 2005, SS2005, displayed detectable concentrations of Pb and NC at 130 ug/g and 45.8 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS2005 were below detection limits.

Igloo 2006

The soil sample from Igloo 2006, SS2006, displayed detectable concentrations of Pb, Hg and NC at 310 ug/g, 0.0766 ug/g, and 67.2 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2006 were below detection limits.

Igloo 2007

The soil sample from Igloo 2007, SS2007, displayed detectable concentrations of Pb and NC at 270 ug/g and 202 ug/g, respectively. Both the Pb and NC concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2007 were below detection limits.

Igloo 2008

The soil sample from Igloo 2008, SS2008, displayed a detectable concentration of Pb at 400 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2008 were below detection limits.

Igloo 2009

The soil sample from Igloo 2009, SS2009, displayed a detectable concentration of Pb at 170 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2009 were below detection limits.

Igloo 2010

Both an investigative (SS2010) and field replicate sample (SS2010R) were collected at this location. Pb was detected at 54 ug/g in SS2010 and at 130 D ug/g in SS2010R. Both these concentrations are above the background concentration range. Concentrations of all other

analytes in both SS2010 and SS2010R were below detection limits. All analytes in SS2010R have flagging codes of D.

Igloo 2101

Both an investigative (SS2101) and matrix spike sample (SS2101MS) were collected at this location. However, it appears that the analytical laboratory analyzed the MS sample as a field replicate sample rather than as a matrix spike sample. Concentrations of Pb, Hg, NC and 2,4-DNT were detected at this location. Pb was detected at 160 ug/g in SS2101 and at 120 D ug/g in SS2101MS. Hg was detected at concentrations of 0.0703 ug/g in SS2101 and at 0.0924 D ug/g in SS2101MS. NC was detected at 44.4 ug/g in SS2101 and at 44.6 D ug/g in SS2101MS. 2,4-DNT was detected at 3.3 ug/g in SS2101 but was below the detection limit in SS2101MS. These Pb and Hg concentrations, and the detected 2,4-DNT concentration, are above their respective background concentration ranges, while these NC concentrations are within its background range. Concentrations of all other analytes in both SS2101 and SS2101MS were below detection limits. All analytes in SS2101MS have flagging codes of D.

Igloo 2102

The soil sample from Igloo 2102, SS2102, displayed detectable concentrations of Pb and Hg at concentrations of 89 ug/g and 0.0682 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2102 were below detection limits.

Igloo 2103

Both an investigative (SS2103) and field replicate sample (SS2103R) were collected at this location. Concentrations of Pb, Hg and NC were detected at this location. Pb was detected at 60 ug/g in SS2103 and at 52 D ug/g in SS2103R. Hg was detected at 0.0662 ug/g in SS2103 and at 0.0671 D ug/g in SS2103R. NC was below the detection limit in SS2103, but was detected at 67.6 D ug/g in SS2103R. These Pb and Hg concentrations are above their respective background concentration ranges, while these NC concentrations are within its background range. Concentrations of all other analytes in both SS2103 and SS2103R were below detection limits. All analytes in SS2103R have flagging codes of D.

Igloo 2104

The soil sample from Igloo 2104, SS2104, displayed a detectable concentration of Pb at 28 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2104 were below detection limits.

Igloo 2105

The soil sample from Igloo 2105, SS2105, displayed detectable concentrations of Pb and Hg at 41 ug/g and 0.111 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2105 were below detection limits.

Igloo 2108

The soil sample from Igloo 2108, SS2108, displayed detectable concentrations of Pb, Hg, NC and 2,4-DNT at concentrations of 470 ug/g, 0.111 ug/g, 67.7 ug/g, and 22 ug/g, respectively. The Pb, Hg and 2,4-DNT concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2108 were below detection limits.

Igloo 2201

The soil sample from Igloo 2201, SS2201, displayed detectable concentrations of Pb and Hg at 100 ug/g and 0.0676 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2201 were below detection limits.

Igloo 2202

The soil sample from Igloo 2202, SS2202, displayed detectable concentrations of Pb, Hg and NC at 630 ug/g, 0.389 ug/g, and 131 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2202 were below detection limits.

Igloo 2203

Both an investigative (SS2203) and field replicate sample (SS2203R) were collected at this location. Concentrations of Pb and Hg were detected at this location. Pb was detected at 35 ug/g in SS2203 and at 120 D ug/g in SS2203R. Hg was detected at 0.0892 ug/g in SS2203 and at 0.0913 D ug/g in SS2203R. These Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in both SS2203 and SS2203R were below detection limits. All analytes in SS2303R have flagging codes of D.

Igloo 2204

The soil sample from Igloo 2204, SS2204, displayed detectable concentrations of Pb, Hg and NC at 62 ug/g, 0.0699 ug/g, and 207 ug/g, respectively. These concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2204 were below detection limits.

Igloo 2205

The soil sample from Igloo 2205, SS2205, displayed detectable concentrations of Pb, Hg and NC at 180 ug/g, 0.111 ug/g, and 49.9 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2205 were below detection limits.

Igloo 2206

The soil sample from Igloo 2206, SS2206, displayed detectable concentrations of Pb, Hg and NC at 130 ug/g, 0.301 ug/g, and 57.6 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2206 were below detection limits.

Igloo 2301

The soil sample from Igloo 2301, SS2301, displayed a detectable concentration of Pb at 170 ug/g. This concentration is above the background concentration range. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2301 were below detection limits.

Igloo 2302

The soil sample from Igloo 2302, SS2302, displayed detectable concentrations of Pb and Hg at 360 ug/g and 0.121 ug/g, respectively. These concentrations are above their respective background concentration ranges. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2302 were below detection limits.

Igloo 2303

The soil sample from Igloo 2303, SS2303, displayed detectable concentrations of Pb and Hg at 600 ug/g and 0.205 ug/g, respectively. These concentrations are above their respective background concentration ranges. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2303 were below detection limits.

Igloo 2304

Both an investigative (SS2304) and field replicate sample (SS2304R) were collected at this location. Concentrations of Pb, Hg and 2,4-DNT were detected at this location. Pb was detected at 150 ug/g in SS2304 and at 99 D ug/g in SS2304R. Hg was detected at 0.624 ug/g in SS2304 and at 0.314 ug/g in SS2304R. 2,4-DNT was detected at 4.62 D ug/g in SS2304R, but was below the detection limit in SS2304. Both Pb concentrations, both Hg concentrations, and the detected 2,4-DNT concentration, are above their respective background concentration ranges. Although the samples were submitted for analysis of NC, no analytical results are available for this analyte. Concentrations of all other analytes in both SS2304 and SS2304R were below detection limits. All analytes in SS2304R have flagging codes of D.

Igloo 2305

Both an investigative (SS2305) and matrix spike sample (SS2305MS) were collected at this location. However, it appears that the analytical laboratory analyzed the MS sample as a field replicate sample rather than as a matrix spike sample. Concentrations of Pb and 1,3,5-TNB were detected at this location. Pb was detected at 200 ug/g in SS2305 and at 190 D ug/g in SS2305MS. 1,3,5-TNB was detected at 2.54 D ug/g in SS2305MS, but was below the detection limit in SS2305. Both Pb concentrations, and the 1,3,5-TNB concentration, are above their respective background concentration ranges. Although the samples were submitted for analysis of NC, no analytical results are available for this analyte. Concentrations of all other analytes in both SS2305 and SS2305MS were below detection limits. All analytes in SS2305MS have flagging codes of D.

Igloo 2307

The soil sample from Igloo 2307, SS2307, displayed detectable concentrations of Pb and Hg at 200 ug/g and 0.099 ug/g, respectively. These concentrations are above their respective background concentration ranges. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in sample SS2307 were below detection limits.

Igloo 2308

The soil sample from Igloo 2308, SS2308, displayed detectable concentrations of Pb and Hg at 95 ug/g and 0.0583 ug/g, respectively. These concentrations are above their respective background concentration ranges. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2308 were below detection limits.

Igloo 2310

The soil sample from Igloo 2310, SS2310, displayed a detectable concentration of Pb at 18 ug/g. This concentration is within the background concentration range. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2310 were below detection limits.

Igloo 2402

The soil sample from Igloo 2402, SS2402, displayed detectable concentrations of Pb, Hg and NC at 130 ug/g, 0.109 ug/g, and 223 ug/g, respectively. These concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2402 were below detection limits.

Igloo 2403

The soil sample from Igloo 2403, SS2403, displayed detectable concentrations of Pb, Hg and NC at 310 ug/g, 0.0932 ug/g, and 355 ug/g, respectively. These concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2403 were below detection limits.

Igloo 2404

The soil sample from Igloo 2404, SS2404, displayed detectable concentrations of Pb, Hg and NC at 150 ug/g, 0.0659 ug/g, and 303 ug/g, respectively. These concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2404 were below detection limits.

Igloo 2405

The soil sample from Igloo 2405, SS2405, displayed detectable concentrations of Pb, Hg and NC at 280 ug/g, 0.109 ug/g, and 53.8 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2405 were below detection limits.

Igloo 2406

The soil sample from Igloo 2406, SS2406, displayed detectable concentrations of Pb, Hg and NC at 93 ug/g, 0.109 ug/g, and 135 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2406 were below detection limits.

Igloo 2407

The soil sample from Igloo 2407, SS2407, displayed detectable concentrations of Pb, Hg and NC at 110 ug/g, 0.111 ug/g, and 91.6 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2407 were below detection limits.

Igloo 2501

Both an investigative (SS2501) and field replicate sample (SS2501R) were collected at this location. Pb was detected at 13 ug/g in SS2501 and at 84 D ug/g in SS2501R. The higher Pb concentration is above the background concentration range, while the lower concentration is within the background range. Hg was detected at 0.200 ug/g in SS2501 and at 0.253 D ug/g in SS2501R. Both these Hg concentrations are above the background concentration. Although both samples were submitted for analysis of NC, no analytical results are available for this analyte. Concentrations of all other analytes in both SS2501 and SS2501R were below detection limits. All analytes in SS2501R have flagging codes of D.

Igloo 2502

The soil sample from Igloo 2502, SS2502, displayed detectable concentrations of Pb and Hg at 64 ug/g and 0.0745 ug/g, respectively. These concentrations are above their respective background concentration ranges. Although the sample was submitted for analysis of NC, no

analytical result is available for this analyte. Concentrations of all other analytes in SS2502 were below detection limits.

Igloo 2503

The soil sample from Igloo 2503, SS2503, displayed detectable concentrations of Pb and Hg at 130 ug/g and 0.0757 ug/g, respectively. These concentrations are above their respective background concentration ranges. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2503 were below detection limits.

Igloo 2602

The soil sample from Igloo 2602, SS2602, displayed a detectable concentration of Pb at 210 ug/g. This concentration is above the background concentration range. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2602 were below detection limits.

Igloo 2603

The soil sample from Igloo 2603, SS2603 displayed a detectable concentration of Pb at 79 ug/g. This concentration is above the background concentration range. Although the sample was submitted for analysis of NC, no analytical result is available for this analyte. Concentrations of all other analytes in SS2603 were below detection limits.

Igloo 2604

The soil sample from Igloo 2604, SS2604, displayed detectable concentrations of Pb, Hg and NC at concentrations of 130 ug/g, 0.0706 ug/g, and 100 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2604 were below detection limits.

Igloo 2605

Both an investigative (SS2605) and field replicate sample (SS2605R) were collected at this sample location. Concentrations of Pb and NC were detected at this location. Pb was detected at 27 ug/g in SS2605 and at 17 D ug/g in SS2605R. NC was detected at 46.1 ug/g in SS2605, but was below the detection limit in SS2605R. The higher Pb concentration is above its background concentration range, while the lower Pb and both of the NC concentrations are

within their respective background ranges. Concentrations of all other analytes in SS2605 and SS2605R were below detection limits. All analytes in SS2605R have flagging codes of D.

Igloo 2606

The soil sample from Igloo 2606, SS2606, displayed detectable concentrations of Pb and NC at 95 ug/g and 69.1 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS2606 were below detection limits.

Igloo 2608

The soil sample from Igloo 2608, SS2608, displayed detectable concentrations of Pb, Hg and NC at 54 ug/g, 0.0808 ug/g, and 128 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2608 were below detection limits.

Igloo 2609

The soil sample from Igloo 2609, SS2609, displayed detectable concentrations of Pb and NC at 33 ug/g and 47 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS2609 were below detection limits.

Igloo 2610

The soil sample from Igloo 2610, SS2610, displayed detectable concentrations of Pb, Hg and NC at 39 ug/g, 0.0737 ug/g, and 55.2 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS2610 were below detection limits.

Igloo 2612

Both an investigative (SS2612) and matrix spike sample (SS2612MS) were collected at this sample location. Concentrations of Pb, Hg and NC were detected at this location. Pb was detected at 39 ug/g in SS2612 and 43 D ug/g in SS2612MS. Hg was detected at 0.0705 ug/g in SS2612 and at 0.0687 D ug/g in SS2612MS. NC was below the detection limit in SS2612, but was detected at 57.7 D ug/g in SS2612MS. Both Pb and both Hg concentrations are above

their respective background concentration ranges, while the NC concentrations are within its background range. Concentrations of all other analytes in both SS2612 and SS2612MS were below detection limits. All analytes in SS2612MS have flagging codes of D.

Igloo 2613

The soil sample from Igloo 2613, SS2613, displayed detectable concentrations of Pb and NC at 200 ug/g and 48.8 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS2613 were below detection limits.

Igloo 2701

The soil sample from Igloo 2701, SS2701, displayed a detectable concentration of Pb at 120 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2701 were below detection limits.

Igloo 2702

The soil sample from Igloo 2702, SS2702, displayed a detectable concentration of Pb at 150 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2702 were below detection limits. NB has a flagging code of G.

Igloo 2703

The soil sample from Igloo 2703, SS2703, displayed detectable concentrations of Pb and Hg at 250 ug/g and 0.0723 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2703 were below detection limits.

Igloo 2704

The soil sample from Igloo 2704, SS2704, displayed a detectable concentration of Pb at 93 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2704 were below detection limits.

Igloo 2705

The soil sample from Igloo 2705, SS2705, displayed detectable concentrations of Pb and Hg at 300 ug/g and 0.0791 ug/g, respectively. Both the Pb and Hg concentrations are above their

respective background concentration ranges. Concentrations of all other analytes in SS2705 were below detection limits.

Igloo 2707

Both an investigative (SS2707) and field replicate sample (SS2707R) were collected at this location. Pb was detected at 35 ug/g in SS2707, and at 39 D ug/g in SS2707R. These concentrations are above the background concentration range. Concentrations of all other analytes in both SS2707 and SS2707R were below detection limits. All analytes in SS2707R have flagging codes of D.

Igloo 2708

The soil sample from Igloo 2708, SS2708, displayed a detectable concentration of Pb at 63 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2708 were below detection limits.

Igloo 2710

The soil sample from Igloo 2710, SS2710, displayed a detectable concentration of Pb at 51 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2710 were below detection limits.

Igloo 2711

The soil sample from Igloo 2711, SS2711, displayed a detectable concentration of Pb at 110 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2711 were below detection limits.

Igloo 2801

The soil sample from Igloo 2801, SS2801, displayed a detectable concentration of Pb at 60 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2801 were below detection limits.

Igloo 2802

The soil sample from Igloo 2802, SS2802, displayed a detectable concentration of Pb at 280 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2802 were below detection limits.

Igloo 2803

The soil sample from Igloo 2803, SS2803, displayed a detectable concentration of Pb at 130 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2803 were below detection limits. 1,3,5-TNB has a flagging code of G.

Igloo 2804

Both an investigative (SS2804) and field replicate sample (SS2804R) were collected at this location. Concentrations of Pb and Hg were detected at this location. Pb was detected at 120 ug/g in SS2804 and at 190 D ug/g in SS2804R. Hg was below the detection limit in SS2804, but was detected at 0.0955 D ug/g in SS2804R. Both Pb concentrations, and the detected Hg concentration, are above their respective background concentration ranges. Concentrations of all other analytes in both SS2804 and SS2804R were below detection limits. All analytes in SS2804R have flagging codes of D.

Igloo 2806

The soil sample from Igloo 2806, SS2806, displayed detectable concentrations of Pb and NC at 170 ug/g and 47.5 B ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS2806 were below detection limits. As designated by its B flagging code, the reported concentration of NC should be considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2807

Both an investigative (SS2807) and matrix spike sample (SS2807MS) were collected at this location. However, it appears that the analytical laboratory analyzed the MS sample as a field replicate sample rather than as a matrix spike sample. Concentrations of Pb and NC were detected at this location. Pb was detected at concentrations of 160 ug/g in SS2807 and 74 D ug/g in SS2807MS. NC was below the detection limit in SS2807, but was detected at concentrations of 50.7 D ug/g in SS2807MS. Both Pb concentrations are above its background concentration range, while both NC concentrations are within its background range. Concentrations of all other analytes in SS2807 and SS2807MS were below detection limits. The non-detected value for NC in SS2807 has a flagging code of B. All analytes in SS2807MS have flagging codes of D. The reported concentration of 50.7 D ug/g for NC in SS2807MS should have a flagging code of B and should be considered to be less than the detection limit

since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2808

The soil sample from Igloo 2808, SS2808, displayed detectable concentrations of Pb and NC at 110 ug/g, and 55.7 B ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS2808 were below detection limits. The reported concentration of NC in SS2808 should be considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2809

The soil sample from Igloo 2809, SS2809, displayed a detectable concentration of Pb at 90 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2809 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2810

The soil sample from Igloo 2810, SS2810, displayed detectable concentrations of Pb and Hg at 150 ug/g and 0.0718 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2810 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2901

Although the sample from Igloo 2901, SS2901, was submitted for analysis of Pb, no analytical result is available for this analyte. All other analytes in SS2901 were below detection limits. 1,3,5-TNB and NB have flagging codes of G. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2902

The soil sample from Igloo 2902, SS2902, displayed a detectable concentration of Pb at 110 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2902 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2903

The soil sample from Igloo 2903, SS2903, displayed a detectable concentration of Pb at 47 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2903 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2904

The soil sample from Igloo 2904, SS2904, displayed detectable concentrations of Pb and Hg at 28 ug/g and 0.0867 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS2904 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2905

Both an investigative (SS2905) and field replicate sample (SS2905R) were collected at this location. Pb was detected at concentrations of 32 ug/g in SS2905 and at 33 D ug/g in SS2905R. Both Pb concentrations are above the background concentration range. Concentrations of all other analytes in both SS2905 and SS2905R were below detection limits. All analytes in SS2905R have flagging codes of D. As designated by its B flagging code, the reported concentration of NC in SS2905 is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample. Likewise, the non-detected concentration of NC for

SS2905R should also have a B flagging code rather than the D flagging code presented in IRDMIS.

Igloo 2906

The soil sample from Igloo 2906, SS2906, displayed a detectable concentration of Pb at 200 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2906 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2908

The soil sample from Igloo 2908, SS2908, displayed a detectable concentration of Pb at 37 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2908 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2909

The soil sample from Igloo 2909, SS2909, displayed a detectable concentration of Pb at 53 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS2909 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 2910

The soil sample from Igloo 2910, SS2910, displayed a detectable concentration of Pb. The analytical laboratory reported two Pb analytical results for this sample, one at 33 ug/g and one at 57 ug/g. Both Pb concentrations are above the background concentration range. Concentrations of all other analytes in SS2910 were below detection limits. As designated by its B flagging code, the reported concentration of NC is considered to be less than the detection limit since, as discussed above under Section 4.1.5, the blank for this analytical lot (Lot OUF) contained a value near that reported for this sample.

Igloo 3001

The soil sample from Igloo 3001, SS3001, displayed a detectable concentration of Pb at 22.5 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3001 were below detection limits.

Igloo 3002

The soil sample from Igloo 3002, SS3002, displayed a detectable concentration of Pb at 28 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3002 were below detection limits.

Igloo 3003

The soil sample from Igloo 3003, SS3003, displayed detectable concentrations of Pb and Hg at 56 ug/g and 0.0670 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SS3003 were below detection limits.

Igloo 3005

The soil sample from Igloo 3005, SS3005, displayed a detectable concentration of Pb at 62 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3005 were below detection limits.

Igloo 3006

The soil sample from Igloo 3006, SS3006, displayed a detectable concentration of Pb at 41 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3006 were below detection limits.

Igloo 3007

The soil sample from Igloo 3007, SS3007, displayed a detectable concentration of Pb at 33 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3007 were below detection limits.

Igloo 3008

The soil sample from Igloo 3008, SS3008, displayed a detectable concentration of Pb at 21 ug/g. This concentration is marginally above the background concentration range. Concentrations of all other analytes in SS3008 were below detection limits.

Igloo 3009

The soil sample from Igloo 3009, SS3009, displayed detectable concentrations of Pb, Hg and NC at 32 ug/g, 0.144 ug/g, and 44.4 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS3009 were below detection limits.

Igloo 3010

Both an investigative (SS3010) and field replicate sample (SS3010R) were collected at this location. Concentrations of Pb and NC were detected at this location. Pb was detected at 19 ug/g in SS3010 and at 23 D ug/g in SS3010R. NC was below the detection limit in SS3010, but was detected at 42.4 D ug/g in SS3010R. Both Pb concentrations are marginally above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in both SS3010 and SS3010R were below detection limits. All analytes in SS3010R have flagging codes of D.

Igloo 3011

The soil sample from Igloo 3011, SS3011, displayed a detectable concentration of Pb at 49 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3011 were below detection limits.

Igloo 3101

The soil sample from Igloo 3101, SS3101, displayed a detectable concentration of Pb at 54 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3101 were below detection limits.

Igloo 3102

The soil sample from Igloo 3102, SS3102, displayed detectable concentrations of Pb and Hg at 30 ug/g and 0.122 ug/g, respectively. Both the Pb and Hg concentrations are above their

respective background concentration ranges. Concentrations of all other analytes in SS3102 were below detection limits.

Igloo 3106

Both an investigative (SS3106) and field replicate sample (SS3106R) were collected at this location. Concentrations of Pb and NC were detected at this location. Pb was detected at 62 ug/g in SS3106 and at 140 D ug/g in SS3106R. NC was detected at 46.7 ug/g in SS3106, but was below the detection limit in SS3106R. Both Pb concentrations are above its background concentration range, while both NC concentrations are within its background range. Concentrations of all other analytes in both SS3106 and SS3106R were below detection limits. All analytes in SS3106R have flagging codes of D.

Igloo 3107

The soil sample from Igloo 3107, SS3107, displayed a detectable concentration of Pb at 680 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3107 were below detection limits.

Igloo 3108

Both an investigative (SS3108) and matrix spike sample (SS3108MS) were collected at this location. However, it appears that the analytical laboratory analyzed the MS sample as a field replicate sample rather than as a matrix spike sample. Concentrations of Pb, Hg and NC were detected at this location. Pb was detected at 32 ug/g in SS3108 and at 29 D ug/g in SS3108MS. Hg was below the detection limit in SS3108, but was detected at 0.0659 D ug/g in SS3108MS. NC was below the detection limit in SS3108, but was detected at 45.8 D ug/g in SS3108MS. Both Pb concentrations, and the detected Hg concentration, are above their respective background concentration ranges, while both NC concentrations are within its background range. Concentrations of all other analytes in both SS3108 and SS3108MS were below detection limits. All analytes in SS3108MS have flagging codes of D.

Igloo 3110

The soil sample from Igloo 3110, SS3110, displayed a detectable concentration of Pb at 20 ug/g. This concentration is marginally above the background concentration range. Concentrations of all other analytes in SS3110 were below detection limits.

Igloo 3301

The soil sample from Igloo 3301, SS3301, displayed detectable concentrations of Pb, Hg and NC at 120 ug/g, 0.110 ug/g, and 97.1 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS3301 were below detection limits.

Igloo 3302

The soil sample from Igloo 3302, SS3302, displayed detectable concentrations of Pb, Hg and NC at 47 ug/g, 0.0666 ug/g, and 42.4 ug/g, respectively. Both the Pb and Hg concentrations are above their respective background concentration ranges, while the NC concentration is within its background range. Concentrations of all other analytes in SS3302 were below detection limits.

4.4 LOADING RAMP AREAS

Five loading ramps (3404, 3405, 3406, 3407, and 3408) exist at the Annex along a former looped railroad spur. Each loading ramp soil sample was analyzed for the same baseline suite of analytical parameters: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Pb, Hg and NC were detected at more than one loading ramp (five, two and three, respectively). 2,4-DNT was also detected above background in one sample from a loading ramp. Concentrations of all other analytes were below detection limits.

Concentrations of these detected analytes are presented along with analytes detected in other soil samples on Figure 4-2, showing only the highest concentration of an analyte detected at the sample station. Table 6-2 presents a summary of chemicals detected in soil. Full analytical results for all soil samples are presented in Appendix G.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Background Soil Concentrations

As discussed above under Section 4.2.1, Pb and NC were detected in the background soil samples. Concentrations of Pb in the background samples range from 12 to 18 ug/g. Concentrations of NC range from not detected (at a detection limit of 23.1 ug/g) to 155 ug/g. Concentrations of all other analytes, including BETX and TRPH/TPHC, were below detection limits.

Loading Ramp 3404

Four four-point composite soil samples were collected from Loading Ramp 3404 -- SS3404A, SS3404B, SS3404C and SS3404D. Pb was detected at this location at 74 ug/g, 34 ug/g, 46 ug/g and 50 ug/g, respectively. These concentrations are all above the background concentration range. Concentrations of all other analytes in SS3404A, SS3404B, SS3404C and SS3404D were below detection limits.

Loading Ramp 3405

A total of two, four-point composite soil samples (SS3405A and SS3405B) and two grab soil samples (SS3405C and SS3405D) were collected from Loading Ramp 3405. Concentrations of Pb, Hg, NC, and 2,4-DNT above their respective background ranges were detected at this location. Pb was detected at 17 ug/g in SS3405A, 100 ug/g in SS3405B, 100 ug/g in SS3405C, and 520 ug/g in SS3405D. Hg was detected at 0.123 ug/g in SS3405A, 0.109 ug/g in SS3405C, and 0.0620 ug/g in SS3405D, but was below the detection limit in SS3405B. NC was detected at 258 ug/g in SS3405D (biased low as discussed above under Section 4.1.5), but was below the detection limit in SS3405A, SS3405B and SS3405C. 2,4-DNT was detected at concentrations of 5.62 ug/g in SS3405C and 3.64 ug/g in SS3405D, but was below the detection limit in SS3405A and SS3405B. Concentrations of all other analytes in SS3405A, SS3405B, SS3405C and SS3405D were below detection limits.

Loading Ramp 3406

The single four-point composite soil sample from Loading Ramp 3406, SS3406, displayed detectable concentrations of Pb and NC at 95 ug/g and 27 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background range. Concentrations of all other analytes in SS3406 were below detection limits.

Loading Ramp 3407

The single four-point composite soil sample from Loading Ramp 3407, SS3407, displayed a detectable concentration of Pb at 58 ug/g. This concentration is above the background concentration range. Concentrations of all other analytes in SS3407 were below detection limits.

Loading Ramp 3408

A single four-point composite soil sample, consisting of an investigative (SS3408A) and field replicate sample (SS3408AR), as well as three two-point composite soil samples (SS3408B, SS3408C and SS3408D) were collected from Loading Ramp 3408. The analytical results for both the investigative (SS3408A) and field replicate (SS3408AR) samples are reported jointly in IRDMIS under the identifier SS3408A. Concentrations of Pb and Hg above their respective background concentration ranges, and NC within its background range, were detected at this location. Pb was detected at concentrations of 22 ug/g in SS3408A, 25 ug/g in SS3408AR, 22 ug/g in SS3408B, 32 ug/g in SS3408C and 25 ug/g in SS3408D. Hg was detected at concentrations of 0.0656 ug/g in SS3408A, 0.0669 ug/g in SS3408AR, 0.0648 ug/g in SS3408B, 0.0647 ug/g in SS3408C and 0.0635 ug/g in SS3408D. NC was detected at a concentration of 27.4 ug/g in SS3408D, but was below the detection limit in SS3408A, SS3408AR, SS3408B and SS3408C. Concentrations of all other analytes in SS3408A, SS3408AR, SS3408B, SS3408C and SS3408D were below detection limits.

4.5 DEBRIS PILE

The debris pile consists of empty wooden packing crates, empty wooden ammunition boxes, wooden pallets, empty mortar shell casings, and general paper waste. Four surface soil grab samples were collected from the soil beneath the debris pile. Two samples were collected on the north side of the debris pile, one from each corner; likewise, two samples were collected from the south side of the debris pile, one from each corner. Each debris pile soil sample was analyzed for the same baseline suite of analytical parameters: (1) the metals Pb and Hg; (2) NC; (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl; (4) BETX; and (5) TRPH (abbreviated in IRDMIS as TPHC).

Pb, Hg, and NC were detected in several soil samples from the debris pile (four, two and two, respectively). Low levels of methylbenzene (toluene, abbreviated in IRDMIS as MEC6H5) were also detected in two of the debris pile samples.

Concentrations of these detected analytes are presented along with analytes detected in other soil samples on Figure 4-2, showing only the highest concentration of an analyte detected at the sample station. Table 6-2 presents a summary of chemicals detected in soil. Full analytical results for all soil samples are presented in Appendix G.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Background Soil Concentrations

As discussed above under Section 4.2.1, Pb and NC were detected in the background soil samples. Concentrations of Pb in the background samples range from 12 to 18 ug/g. Concentrations of NC range from not detected (at a detection limit of 23.1 ug/g) to 155 ug/g. Concentrations of all other analytes, including BETX and TRPH/TPHC, were below detection limits.

Debris Pile

Four grab soil samples -- SSDP01, SSDP02, SSDP03, and SSDP04 -- were collected from the debris pile. Concentrations of Pb, Hg and methylbenzene (toluene, abbreviated as MEC6H5 in IRDMIS) above their respective background concentration ranges, and NC within its background range, were detected at the debris pile. Pb was detected at 24 ug/g in SSDP01, 60 ug/g in SSDP02, 31 ug/g in SSDP03, and 29 ug/g in SSDP04. Hg was detected at 0.0688 ug/g in SSDP03 and 0.0645 ug/g in SSDP04, but was below the detection limit in SSDP01 and SSDP02. Methylbenzene was detected at 1.24 ug/g in SSDP01 and 1.18 ug/g in SSDP02, but was below the detection limit in SSDP03 and SSDP04. NC was detected at 39.7 ug/g in SSDP01 and 29.5 ug/g in SSDP03, but was below the detection limit in SSDP02 and SSDP04. Concentrations of all other analytes, including BETX and TRPH/TPHC, in SSDP01, SSDP02, SSDP03 and SSDP04 were below detection limits. As discussed above under Section 4.1.5, all analytical results for 1,3,5-TNB for these samples were unusable due to low spike recovery during analysis of this lot, Lot ORT.

4.6 GROUND DISTURBANCES

Twenty one ground disturbances identified during previous planning activities were sampled during this EI. Ground disturbances 7, 12, 14, and 15 are large disturbances, and were collected as two different samples, an "A" sample and a "B" sample. The other ground disturbances consisted of a single undifferentiated sample. All ground disturbance soil samples were analyzed for the same baseline suite of analytical parameters: (1) the metals Pb

and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Pb and Hg were detected above background in numerous soil samples collected from the ground disturbances. NC was also detected in numerous (13) soil samples.

Concentrations of these detected analytes are presented along with analytes detected in other soil samples on Figure 4-2, showing only the highest concentration of an analyte detected at the sample station. Table 6-2 presents a summary of chemicals detected in soil. Full analytical results for all soil samples are presented in Appendix G.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Background Soil Concentrations

As discussed above under Section 4.2.1, Pb and NC were detected in the background soil samples. Concentrations of Pb in the background samples range from 12 to 18 ug/g. Concentrations of NC range from not detected (at a detection limit of 23.1 ug/g) to 155 ug/g. Concentrations of all other analytes were below detection limits.

Ground Disturbance 1

The soil sample from Ground Disturbance 1, SSGD01, displayed detectable concentrations of Pb and NC at 19.5 ug/g and 184 ug/g, respectively. Both of these concentrations are above their respective background concentration ranges. Concentrations of all other analytes in SSGD01 were below detection limits.

Ground Disturbance 2

The soil sample from Ground Disturbance 2, SSGD02, displayed detectable concentrations of Pb, Hg and NC at 14.7 ug/g, 0.0623 ug/g and 86.8 ug/g, respectively. The Hg concentration is above its background concentration, while both the Pb and NC concentrations are within their respective background concentration ranges. Concentrations of all other analytes in SSGD02 were below detection limits.

Ground Disturbance 3

The soil sample from Ground Disturbance 3, SSGD03, displayed a detectable concentration of Pb at 11.2 ug/g. This concentration is within its background concentration range. Concentrations of all other analytes in SSGD03 were below detection limits.

Ground Disturbance 4

The soil sample from Ground Disturbance 4, SSGD04, displayed detectable concentrations of Pb and NC at 13.3 ug/g and 54.9 ug/g, respectively. Both of these concentrations are within their respective background concentration ranges. Concentrations of all other analytes in SSGD04 were below detection limits.

Ground Disturbance 5

The soil sample from Ground Disturbance 5, SSGD05, displayed detectable concentrations of Pb and NC at 26.0 ug/g and 99.0 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background concentration range. Concentrations of all other analytes in SSGD05 were below detection limits.

Ground Disturbance 6

The soil sample from Ground Disturbance 6, SSGD06, displayed detectable concentrations of Pb and NC at 98.2 ug/g and 60.2 ug/g, respectively. The Pb concentration is above its background concentration range, while the NC concentration is within its background concentration range. Concentrations of all other analytes in SSGD06 were below detection limits.

Ground Disturbance 7

Two four-point composite soil samples (SSGD07A and SSGD07B) were collected from Ground Disturbance 7. Pb was detected at concentrations of 22.0 ug/g in SSGD07A and at 11.0 ug/g in SSGD07B. Hg was detected at concentrations of 0.0637 ug/g in SSGD07A and 0.0500 ug/g in SSGD07B. Both Hg concentrations are above its background concentration range, while only the 22.0 ug/g Pb concentration in SSGD07A is above its background concentration range. Concentrations of all other analytes in SSGD07A and SSGD07B were below detection limits. As discussed above under Section 4.1.5, all analytical results for 1,3,5-TNB for these samples were unusable due to low spike recovery during analysis of this lot, Lot ORT.

Ground Disturbance 8

Both an investigative (SSGD08) and field replicate sample (SSGD08R) were collected at this sample location. Concentrations of Pb, Hg and NC were detected at Ground Disturbance 8. Pb was detected at 11.0 ug/g in SSGD08, and at 8.25 D ug/g in SSGD08R. Hg was detected at 0.0648 ug/g in SSGD08, but was below the detection limit in SSGD08R. NC was detected at 107 ug/g in SSGD08, and at 67.5 D ug/g in SSGD08R. Both Pb concentrations are below its background concentration range; the detected Hg concentration is above the background concentration range, while both of the NC concentrations are within its background range. Concentrations of all other analytes in SSGD08 and SSGD08R were below detection limits. All analytes in SSGD08R have flagging codes of D.

Ground Disturbance 9

The soil sample from Ground Disturbance 9, SSGD09, displayed detectable concentrations of Pb, Hg and NC at 15.4 ug/g, 0.0615 ug/g and 70.4 ug/g, respectively. The Hg concentration is above its background concentration range, while the Pb and NC concentrations are within their respective background ranges. Concentrations of all other analytes in SSGD09 were below detection limits.

Ground Disturbance 10

The soil sample from Ground Disturbance 10, SSGD10, displayed detectable concentrations of Pb and NC at 9.63 ug/g and 36 ug/g, respectively. Both of these concentrations are within their respective background concentration ranges. Concentrations of all other analytes in SSGD10 were below detection limits.

Ground Disturbance 11

The soil sample from Ground Disturbance 11, SSGD11, displayed a detectable concentration of Pb at 9.45 ug/g. This concentration is below its background concentration range. Concentrations of all other analytes in SSGD11 were below detection limits.

Ground Disturbance 12

Both of the two four-point composite soil samples, SSGD12A and SSGD12B, collected from Ground Disturbance 12 displayed detectable concentrations of Pb at 15.0 ug/g. This concentration is within its background concentration range. Concentrations of all other analytes in SSGD12A and SSGD12B were below detection limits. As discussed above under

Section 4.1.5, all analytical results for 1,3,5-TNB for these samples were unusable due to low spike recovery during analysis of this lot, Lot ORT.

Ground Disturbance 13

The soil sample from Ground Disturbance 13, SSGD13, displayed detectable concentrations of Pb, Hg and NC at 12.1 ug/g, 0.0695 ug/g and 31.7 ug/g, respectively. The Hg concentration is above its background concentration range, while both the Pb and NC concentrations are within their respective background ranges. Concentrations of all other analytes in SSGD13 were below detection limits.

Ground Disturbance 14

The two four-point composite soil samples, SSGD14A and SSGD14B, collected from Ground Disturbance 14 displayed detectable concentrations of Pb and NC. Pb was detected at 9.80 ug/g in SSGD14A, and at 14.0 ug/g in SSGD14B. These Pb concentrations are either below (9.80 ug/g) or within (14.0 ug/g) its background concentration range. NC was detected at 36.5 ug/g in SSGD14A, but was below the detection limit in SSGD14B. Both NC concentrations are within its background concentration range. Concentrations of all other analytes in SSGD14A and SSGD14B were below detection limits. As discussed under Section 4.1.5, all analytical results for 1,3,5-TNB for these samples were unusable due to low spike recovery during analysis of this lot, Lot ORT.

Ground Disturbance 15

Two investigative samples (SSGD15A and SSGD15B) and one field replicate sample (SSGD15AR) were collected at this location. Detectable concentrations of Pb and Hg were displayed at this location. Pb was detected at 5.60 ug/g in SSGD15A, at 12.0 ug/g in SSGS15AR, and at 23.0 ug/g in SSGD15B. The first two Pb concentrations are either below (5.60 ug/g) or within (14.0 ug/g) its background concentration range, while the 23.0 ug/g concentration is above the background range. Hg was detected at 0.0738 ug/g in SSGD15B, but was below the detection limit in both SSGD15A and SSGD15AR. This detected Hg concentration is above its background concentration range. Concentrations of all other analytes in SSGD15A, SSGD15AR and SSGD15B were below detection limits. As discussed under Section 4.1.5, all analytical results for 1,3,5-TNB for these samples were unusable due to low spike recovery during analysis of this lot, Lot ORT.

Ground Disturbance 16

The soil sample from Ground Disturbance 16, SSGD16, displayed a detectable concentration of Pb at 7.44 ug/g. This concentration is below its background concentration range. Concentrations of all other analytes in SSGD16 were below detection limits.

Ground Disturbance 17

The soil sample from Ground Disturbance 17, SSGD17, displayed detectable concentrations of Pb and NC at 6.09 ug/g and 38.4 ug/g, respectively. This Pb concentration is below its background concentration range, while this NC concentration is within its background concentration range. Concentrations of all other analytes in SSGD17 were below detection limits.

Ground Disturbance 18

The soil sample from Ground Disturbance 18, SSGD18, displayed a detectable concentration of Pb at 14.0 ug/g. This Pb concentration is within its background concentration range. Concentrations of all other analytes in SSGD18 were below detection limits.

Ground Disturbance 19

The soil sample from Ground Disturbance 19, SSGD19, displayed detectable concentrations of Pb and NC at 11.4 ug/g and 90.6 ug/g, respectively. This Pb concentration is below its background concentration range, while this NC concentration is within its background concentration range. Concentrations of all other analytes in SSGD19 were below detection limits.

Ground Disturbance 20

The soil sample from Ground Disturbance 20, SSGD20, displayed a detectable concentration of Pb at 11.5 ug/g. This concentration is below its background concentration range. Concentrations of all other analytes in SSGD20 were below detection limits.

Ground Disturbance 21

The soil sample from Ground Disturbance 21, SSGD21, displayed detectable concentrations of Pb and NC at 12.0 ug/g and 77.4 ug/g, respectively. Both of these concentrations are within their respective background concentration ranges. Concentrations of all other analytes in SSGD21 were below detection limits.

4.7 EXCAVATED PONDS

Surface water and sediment samples were obtained from four onsite ponds and from one background wetland pond located in the buffer zone to the northeast of the Annex.

4.7.1 SURFACE WATER

Each pond surface water sample was analyzed for the same baseline suite of analytical parameters as the sediment sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

The concentration of NC in all four onsite ponds exceeded the concentration in the offsite background wetland pond. Concentrations of all other reported analytes in pond surface waters were below detection limits.

Concentrations of analytes detected in surface water samples are presented on Figure 4-3, showing only the highest concentration of an analyte detected at the sample station. Table 6-3 presents a summary of chemicals detected in surface water. Full reported analytical results for all surface water samples are presented in Appendix I. Table 4-2 presents measured field parameter results for surface water sample stations.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Background Pond

As discussed above under Section 4.2.2.1, the surface water sample from the background wetland pond, SWBG11, displayed a detectable concentration of NC at 431 ug/L. Concentrations of all other analytes in sample SWBG11 were below detection limits.

Onsite Pond 1

The surface water sample from Onsite Pond 1, SWPD01, displayed a detectable concentration of NC at 1,510 ug/L. This concentration is above the NC concentration of 431 ug/L found in the background wetland pond sample, SWBG11. Concentrations of all other analytes were all below detection limits.

Onsite Pond 2

The surface water sample from Onsite Pond 2, SWPD02, displayed a detectable concentration of NC at 732 ug/L. This concentration is above the NC concentration of 431 ug/L found in the background wetland pond sample, SWBG11. Concentrations of all other analytes were all below detection limits.

Onsite Pond 3

The surface water sample from Onsite Pond 3, SWPD03, displayed a detectable concentration of NC at 595 ug/L. This concentration is above the NC concentration of 431 ug/L found in the background wetland pond sample, SWBG11. Concentrations of all other analytes were all below detection limits.

Onsite Pond 4

Both an investigative (SWPD04) and field replicate sample (SWPD04R) were collected at this sample location. The analytical results for both samples are reported jointly in IRDMIS under the identifier SWPD04. NC was detected in both samples at 476 ug/L and 569 ug/L. These concentrations are above the NC concentration of 431 ug/L found in the background wetland pond sample, SWBG11. Concentrations of all other analytes in SWPD04 were all below detection limits.

4.7.2 SEDIMENT

Each pond sediment sample was analyzed for the same baseline suite of analytical parameters as the surface water sample collected from that pond: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of 2,4-DNT, 2,6-DNT, 2,4,6-TNT, NB, 1,3-DNB, 1,3,5-TNB, and tetryl.

Although concentrations of Pb and NC were detected in the majority (4/4 and 3/4, respectively) of onsite pond sediment samples, the range of detected concentrations does not exceed the concentration detected in the background pond sediment sample.

Concentrations of these detected analytes are presented along with analytes detected in other sediment samples on Figure 4-3, showing only the highest concentration of an analyte detected at the sample station. Table 6-3 presents a summary of chemicals detected in sediment. Full analytical results for all sediment samples are presented in Appendix K.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Background Pond

As discussed above under Section 4.1.2.2, the sediment sample from the background wetland pond, SEBG11, displayed detectable concentrations of Pb and NC at concentrations of 22 ug/g and 150 ug/g, respectively. The other analytes in sample SEBG11 were below detection limits.

Pond 1

The sediment sample from Pond 1, SEPD01, displayed detectable concentrations of Pb and NC at 16 ug/g and 55.5 ug/g, respectively. Note that both of these concentrations are below the Pb and NC concentrations of 22 ug/g and 150 ug/g, respectively, found in the background wetland pond sample, SEBG11. Concentrations of all other analytes in SEPD01 were below detection limits.

Pond 2

The sediment sample from Pond 2, SEPD02, displayed a detectable concentration of Pb at 16 ug/g. Note that this concentration is below the Pb concentration of 22 ug/g found in the background wetland pond sample, SEBG11. Concentrations of all other analytes in SEPD02 were below detection limits.

Pond 3

The sediment sample from Pond 3, SEPD03, displayed detectable concentrations of Pb and NC at 20 ug/g and 72.4 ug/g, respectively. Note that both of these concentrations are below the Pb and NC concentrations of 22 and 150 ug/g, respectively, found in the background wetland pond sample, SEBG11. Concentrations of all other analytes in SEPD03 were below detection limits.

Pond 4

Both an investigative (SEPD04) and field replicate sample (SEPD04R) were collected at this sample location. The analytical results for both samples are reported jointly in IRDMIS under the identifier SEPD04. Pb and NC were detected in both SEPD04 and its field replicate SEPD04R. Pb was detected in both samples at 21 ug/g and 22 ug/g, respectively. NC was

detected in both samples at 69.5 ug/g and 74.2 ug/g, respectively. Note that both Pb and both NC concentrations are below their respective concentrations found in the background wetland pond sample, SEBG11. Concentrations of all other analytes in both SEPD04 and SEPD04R were below detection limits.

4.8 STREAMS

Surface water and sediment samples were obtained from two background upstream locations immediately offsite, from six onsite stream locations, and from two downstream locations immediately offsite.

4.8.1 SURFACE WATER

Each stream surface water sample was analyzed for the same baseline suite of analytical parameters as the sediment sample collected from that stream: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of NB, 1,3-DNB, 1,3,5-TNB, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, and tetryl.

Values from the two upstream samples, SW01 and SW02, are assumed to be representative of background concentrations. One upstream sample, SW02 from Stream Station 2, displayed a detectable level of Pb at 5.72 ug/L, while the Pb concentration in SW01 from Stream Station 1 was below the detection limit (4.47 ug/L).

Only one onsite or downstream stream sample -- from the onsite Stream Station 5 -- displayed a detectable concentration of Pb, although that 6.3 ug/L concentration was not markedly above the background concentration, which ranges between non-detectable (with a detection limit of 4.47 ug/L) to 5.72 ug/L. Concentrations of all other analytes were below detection limits.

The concentration of this detected analyte is presented along with analytes detected in other surface water samples on Figure 4-3, showing only the highest concentration of an analyte detected at the sample station. Table 6-3 presents a summary of chemicals detected in surface water. Full surface water analytical results are presented in Appendix I. Table 4-2 presents measured field parameter results for surface water sample stations.

The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Stream Station 1 - Upstream

Concentrations of all analytes in upstream surface water sample SW01 were below detection limits. The analytical result for 1,3,5-TNB has a flagging code of G.

Stream Station 2 - Upstream

The upstream surface water sample SW02 displayed a detectable concentration of Pb at 5.72 ug/L. Concentrations of all other analytes in SW02 were below detection limits. The analytical result for 1,3,5-TNB has a flagging code of G.

Stream Station 3 - Onsite

Concentrations of all analytes in onsite stream surface water sample SW03 were below detection limits. The analytical result for 1,3,5-TNB has a flagging code of G.

Stream Station 4 - Onsite

Concentrations of all analytes in onsite stream surface water sample SW04 were below detection limits.

Stream Station 5 - Onsite

Both an investigative (SW05) and field replicate sample (SW05R) were collected at this onsite stream sample location. The analytical results for both samples are reported jointly in IRDMIS under the identifier SW05. Pb was detected in one of the samples at a concentration of 6.33 ug/L, but was below the detection limit in the field replicate sample. This concentration is not markedly above 5.72 ug/L, the only detected concentration found in the two upstream station samples. Concentrations of all other analytes in both SW05 and SW05R surface water samples were below detection limits.

Stream Station 6 - Onsite

Concentrations of all analytes in onsite stream surface water sample SW06 were below detection limits.

Stream Station 7 - Onsite

Concentrations of all analytes in onsite stream surface water sample SW07 were below detection limits.

Stream Station 8 - Onsite

Concentrations of all analytes in onsite stream surface water sample SW08 were below detection limits.

Stream Station 9 - Downstream

Concentrations of all analytes in downstream surface water sample SW09 were below detection limits.

Stream Station 10 - Downstream

Concentrations of all analytes in downstream surface water sample SW10 were below detection limits. The analytical result for 1,3,5-TNB has a flagging code of G.

4.8.2 SEDIMENT

Each stream sediment sample was analyzed for the same baseline suite of analytical parameters as the surface water sample collected from that stream: (1) the metals Pb and Hg; (2) NC; and (3) nitroaromatics/explosives, consisting of NB, 1,3-DNB, 1,3,5-TNB, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, and tetryl.

Pb was detected in all samples. Values from the two upstream samples, SE01 and SE02, collected at locations selected to be representative of background, display Pb concentrations of 20 ug/g and 33.0 ug/g, respectively. Pb concentrations in the other samples range between 4.74 ug/g and 17.0 ug/g, which are below the two background Pb concentrations. Concentrations of all other analytes were below detection limits.

Concentrations of this detected analyte are presented along with analytes detected in other sediment samples on Figure 4-3, showing only the highest concentration of an analyte detected at the sample station. Table 6-3 presents a summary of chemicals detected in sediment. Full analytical results for all sediment samples are presented in Appendix K. The following paragraphs present a discussion of analytical results on a sample-location-specific basis.

Stream Station 1 - Upstream

The upstream sediment sample SE01 displayed a detectable concentration of Pb at 20 ug/g. Concentrations of all other analytes in SE01 were below detection limits.

Stream Station 2 - Upstream

The upstream sediment sample SE02 displayed a detectable concentration of Pb at 33 ug/g. Concentrations of all other analytes in SE02 were below detection limits.

Stream Station 3 - Onsite

The onsite stream sediment sample SE03 displayed a detectable concentration of Pb at 17 ug/g. This concentration is below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in SE03 were below detection limits.

Stream Station 4 - Onsite

The onsite stream sediment sample SE04 displayed a detectable concentration of Pb at 13 ug/g. This concentration is below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in SE04 were below detection limits.

Stream Station 5 - Onsite

Both an investigative (SE05) and field replicate sample (SE05R) were collected at this onsite stream sediment sample location. The analytical results for both samples are reported jointly under the identifier SE05. Pb was detected at 7.4 ug/g, and at 14 ug/g in its field replicate. These concentrations are below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in both SE05 and SE05R were below detection limits. The surface water samples from this location display similar results for Pb, with a lower (non-detectable) concentration in one sample (SW05R) and a higher (detectable) concentration in the other sample (SW05).

Stream Station 6 - Onsite

The onsite stream sediment sample SE06 displayed a detectable concentration of Pb at 13 ug/g. This concentration is below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in SE06 were below detection limits.

Stream Station 7 - Onsite

The onsite stream sediment sample SE07 displayed a detectable concentration of Pb at 6.05 ug/g. This concentration is below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in SE07 were below detection limits.

Stream Station 8 - Onsite

The onsite stream sediment sample SE08 displayed a detectable concentration of Pb at 4.74 ug/g. This concentration is below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in SE08 were below detection limits.

Stream Station 9 - Downstream

The downstream sediment sample SE09 displayed a detectable concentration of Pb at 16 ug/g. This concentration is below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in SE09 were below detection limits.

Stream Station 10 - Downstream

The downstream sediment sample SE10 displayed a detectable concentration of Pb at 17 ug/g. This concentration is below the background concentration range established by the two upstream sample stations. Concentrations of all other analytes in SE10 were below detection limits. 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB and tetryl have flagging codes of D.

TABLE 4-1

IRDMIS FLAGGING CODES USED
COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

FLAGGING CODE	DESCRIPTION
B	Analyte found in blank as well as sample. This flagging code is used for analytes which are found and quantified above the Certified Reporting Limit (CRL) or at higher-than-normal background levels in the method blank and also in analytical samples.
D	Duplicate sample or test name. This flagging code is used to distinguish analytical results when duplicate analyses are requested. This flagging code should be used for the second (duplicate) sample only.
G	Reported results are affected by interferences or high background. This flagging code is used when levels of analyte at or near the CRL cannot be accurately quantified to the actual CRL due to interference, allowing a different CRL, rather than defaulting to the Methods table.
R	Analyte required for reporting purposes but not currently certified. This flagging code is used to identify GC/MS analytes for which no certification data exists but are a normal part of the EPA methodology. This flagging code is also used to signify that the analyte was not quantitated when used in conjunction with a Boolean of ND.
V	Sample subjected to unusual storage conditions. This flagging code is used when the sample storage conditions may affect the analytical results.

NOTE: Flagging codes are used to indicate other-than-usual analytical conditions or results.

TABLE 4-2

FIELD MEASUREMENTS OF
pH, TEMPERATURE & SPECIFIC CONDUCTIVITY
FOR SURFACE WATER SAMPLES AT THE
COOSA RIVER STORAGE ANNEX

LOCATION	pH	TEMPERATURE (degrees C)	SPECIFIC CONDUCTIVITY (micromhos)
Pond 1	5.46	20.5 (surface)	0.020
		19.6 (3.5 ft depth)	
Pond 2	5.27	20.7 (surface)	0.015
		20.3 (3.0 ft depth)	
Pond 3	5.80	21.5 (surface)	0.020
		19.6 (3.5 ft depth)	
Pond 4	6.16	22.1 (surface)	0.034
		20.6 (2.0 ft depth)	
Background Pond	5.77	21.9 (surface)	0.020
		19.1 (3.5 ft depth)	
Stream Station 1	5.69	20.2	0.016
Stream Station 2	5.69	21.3	0.016
Stream Station 3	5.61	18.7	0.015
Stream Station 4	6.07	19.4	0.021
Stream Station 5	6.10	19.8	0.017
Stream Station 6	6.67	21.5	0.037
Stream Station 7	6.51	18.9 (surface)	0.026
		18.4 (2.5 ft depth)	
Stream Station 8	6.03	18.8 (surface)	0.019
		18.5 (2.0 ft depth)	
Stream Station 9	6.69	18.0 (surface)	0.063
		17.9 (2.0 ft depth)	
Stream Station 10	5.60	18.3	0.014

5.0 CONTAMINANT TRANSPORT AND FATE

The purpose of this section is to evaluate the transport, transformation, and fate of chemicals identified in the media at the Coosa River Storage Annex. Their potential migration routes are defined with emphasis on the physical properties of the media that may affect chemical transport and fate. Next, properties determining environmental fate are presented for the major chemicals detected at the Annex. Finally, the results of the sampling and analysis are interpreted in light of the potential contaminant migration routes and the transport and fate processes presented.

5.1 POTENTIAL MIGRATION ROUTES

5.1.1 AIR

Over the history of operation of the Annex, various mechanisms may have served to release chemicals of potential concern to the atmosphere. These mechanisms include volatilization and fugitive dust generation.

Chemicals of potential concern in the soil were likely windborne on fugitive dust during active operation of the Annex. Since no water service existed at the Annex except in the bathhouse, any spillage of powdered materials in the storage igloos was likely swept out the igloo entrance, onto the concrete pad in front of the igloo, and then onto the soils and vegetative cover around that pad, resulting in fugitive dust generation and windborne transport. Windborne transport of chemicals on fugitive dusts may still be occurring at the Annex, particularly in the areas of denuded ground disturbances. To a limited extent, chemicals from the soil may also have volatilized to the atmosphere in the past, and volatilization may be occurring currently. Once released, the concentrations of any fugitive-dust borne or volatilized chemicals would be reduced through the process of dispersion.

5.1.2 SURFACE WATER

Chemicals of potential concern may have been released to surface water by gravitational settling of fugitive dusts, and by surface water runoff from the Annex.

A review of historical aerial photographs indicates that runoff patterns have remained essentially the same over the life of the Annex after its construction. Figure 2-3 shows surface runoff patterns based upon an evaluation of available topographic maps of the Annex.

Surface water drainage at the Annex follows one of two pathways to reach the Coosa River approximately 15 miles downstream.

Drainage from the mountainous area in the northern and western portions of the Annex flows northwesterly in two small perennial streams approximately four miles before joining Choccolocco Creek, a Coosa River tributary. From this confluence, Choccolocco Creek flows for approximately 10.4 miles to the point where it enters Logan Martin Lake, which is part of the Coosa River.

Three small intermittent streams, which form the headwaters of Kelly Creek, drain the southern and eastern portions of the Annex [Dye, 1984]. These streams flow in drainage ditches from west to east. Kelly Creek flows northeasterly approximately 2.4 miles before joining Cheaha Creek. Cheaha Creek flows to the northwest for approximately three (3) miles where it joins Choccolocco Creek.

Potential releases to surface water can be transferred to other media by volatilization, sedimentation, and sorption. Volatilization depends on the physiochemical properties of the substance (as described in Section 5.2) and the characteristics of the water body. This process would be expected to be significant in the ponds, which have a high surface-area-to-volume ratio. Sedimentation, whereby particulates settle out over time and become mixed with bottom sediment, was likely a more active process during the construction and early operation of the Annex; however, it may still be an active process whenever surface water runoff occurs during and after rainfall events. Hazardous substances can also be transferred from surface water to sediment by sorption of dissolved substances onto suspended solids or bottom sediments. Generally, wetland sediment, because of its high organic matter content and cation exchange capacity, has a tendency to adsorb higher levels of hazardous substances than other sediment types.

Chemicals of potential concern in soil are lead and the nitroaromatics 2,4-DNT and 2,6-DNT.

When lead is released into the environment, it has a long residence time compared to most other pollutants. As a result, lead and its compounds tend to accumulate in soils and sediments, where, due to their low solubility and relative freedom from microbial degradation, they will remain accessible to the food chain and to humans far into the future [Davies, 1990].

The nitroaromatics 2,4-DNT and 2,6-DNT exhibit moderate mobility in soil and, therefore, may potentially leach to groundwater. These compounds are not expected to bioconcentrate in animal or plant life but may sorb (via adsorption or absorption) to sediment.

5.1.3 GROUNDWATER

Precipitation that falls on the Annex may infiltrate any established vegetative cover and percolate downward through soils. Potential chemicals of concern in the subsurface soils may dissolve in the percolating water and migrate as a solute to the water table. Once at the water table, the potential for solutes to be transported by groundwater flow is based on the physical properties of the substance. Based on the concentrations of chemicals of potential concern, it is most probable that any solutes carried down to the water table by percolation will migrate in the dissolved aqueous phase with groundwater, rather than as separate non-aqueous phase liquids.

Chemicals of potential concern in soil are lead and the nitroaromatics 2,4-DNT and 2,6-DNT.

When lead is released into the environment, it has a long residence time compared to most other pollutants. As a result, lead and its compounds tend to accumulate in soils and sediments, where, due to their low solubility and relative freedom from microbial degradation, they will remain.

The nitroaromatics 2,4-DNT and 2,6-DNT exhibit moderate mobility in soil and, therefore, may potentially leach to groundwater.

As discussed previously under Section 1.3.4, groundwater is the exposure pathway of greatest potential concern at the Annex, because it is the major source of local drinking water. However, the Technical Plan determined that it is unlikely that activities conducted at the Annex could have impacted groundwater quality in the area [Dames & Moore, 1990], and investigation of groundwater was outside the scope of this EI (see Section 1.1). Refer to Section 1.3.3 for information on groundwater determined during the UST Secondary Assessment [Geraghty & Miller, 1991b].

5.2 ENVIRONMENTAL FATE

A general discussion of the environmental fate of the potential chemicals of concern, those chemicals detected above background concentrations and above preliminary remediation goals, is presented in the following subsections. The discussions are based upon selected environmental fate parameters compiled in Table 5-1 and described below, and on other available information, including various chemical toxicological profiles prepared by USATHAMA [USATHAMA, 1991a,b,c,d and 1992] and the U.S. EPA [U.S. EPA, 1987].

Emphasis is placed on describing the transport and fate of constituents measured with greatest frequency and at highest concentrations in the particular media, or on those constituents measured in multiple media.

Chemicals of potential concern in soil are lead and the nitroaromatics 2,4-DNT and 2,6-DNT.

Chemicals of potential concern in building interiors are radon in the air matrix, and a variety of nitroaromatic compounds -- nitrobenzene, 1,3,5-TNB and 2,4,6-TNT -- in the building interior surfaces matrix.

The fate of chemicals of potential concern can be estimated based on various physical, chemical and biological parameters (environmental fate parameters). These parameters and their relationships to environmental fate are defined below:

Water solubility - upper limit of a chemical's dissolved concentration at a specified temperature and pressure. The higher the solubility, the greater the potential for water to dissolve the chemical.

Vapor pressure - the pressure exerted by a chemical vapor in equilibrium with its solid or liquid form at any given temperature. The higher the vapor pressure, the more likely a chemical is to exist in a gaseous state.

Henry's Law Constant - a measure of the extent of chemical partitioning between air and water at equilibrium. The higher the Henry's Law Constant, the more likely a chemical is to volatilize than to remain in water.

Soil water partition coefficient (K_{oc}) - a measure of chemical partitioning between organic carbon (soil) and water at equilibrium. The higher the K_{oc} , the more likely a chemical is to bind to soil or sediment than to remain in water.

Bioconcentration factor (BCF) - a measure of the extent of chemical partitioning at equilibrium between a biological medium such as fish tissue or plant tissue and an external medium such as water. The higher the BCF, the greater a chemical's accumulation in living tissue.

5.2.1 LEAD (Pb)

In general, metals may be present as insoluble or soluble salts, based on environmental conditions such as pH, presence or absence of oxygen, and types of anions (such as chloride,

sulfate, and carbonate) present. If released to or deposited on the soil, lead will be retained in the upper 1-2 inches of soil, especially soils with at least 5% organic matter or a pH of 5 or above. Lead is tightly bound to most soils with virtually no leaching under natural conditions, although there is some evidence that lead is taken up by some plants. However, plant uptake is not a significant environmental fate process. When lead is released into the environment, it has a long residence time compared to most other pollutants. Lead is adsorbed onto inorganic salts, organic materials, and hydrous iron and manganese oxides. As a result, lead and its compounds tend to accumulate in soils and sediments, where, due to their low solubility and relative freedom from microbial degradation, they will remain accessible to the food chain and to humans far into the future [Davies, 1990].

Due to its very low vapor pressure and insolubility, volatilization of lead from soil or water will be negligible. When released to the atmosphere lead will be in dust or adsorbed to particulate matter; hence dry or wet deposition are significant environmental transport and fate processes for lead.

5.2.2 NITROAROMATICS

5.2.2.1 Nitrobenzene (NB)

Nitrobenzene (NB) is another nitroaromatic chemical of potential concern on igloo interior surfaces.

The leachability of NB was studied in three typical Norwegian soils, one of which was sandy with low organic content, and two organic soils. The resulting K_{oc} for the sandy soil was 30.6, while for the two organic soils the K_{oc} values were 42.8 and 69.6 [Seip, H. M. et al., *Sci Total Environ* 50: 87-101 (1986) as cited in HSDB, 10 March 1992]. K_{oc} values for two Danish subsoils were 170 and 370 [Loekke, H., *Water Air Soil Pollut* 22: 373-87 (1984) as cited in HSDB, 10 March 1992]. An experimental K_{oc} value of 200 was determined from a column of Lincoln fine sand [Wilson, J. T. et al., *J Environ Qual* 10: 501-6 (1981) as cited in HSDB, 10 March 1992]. These K_{oc} values indicate that NB is moderately absorbed to soil, and if released to soil is expected to leach to groundwater. Biodegradation is expected to occur if released to surface water (two experimental values of half-lives are 1 and 3.8 days) or groundwater. Some volatilization is expected.

Several BCF values are available in the literature. A BCF of <10 was determined from a three-day static test on golden orfe (*Leusiscus idus melantus*) [Frietag, D. et al., *Ecotoxic Environ Safety* 6: 60-81 (1982) as cited in HSDB, 10 March 1992]. The Japanese Ministry of International Trade and Industry also reports a BCF of <10 [Kawasaki, M., *Ecotoxic Environ*

Safety 4:444-54 (1980) as cited in HSDB, 10 March 1992]. Another investigator determined a BCF of 6 in fish (*P. reticulata*) [Canton, J. H. et al., Regul Toxicol Pharmacol 5: 123-31 (1985) as cited in HSDB, 10 March 1992]. Yet another investigator determined a BCF of 15 in a 28-day test on fathead minnows [Veith, G. D. et al., J Fish Res Board Can 36: 1040-8 (1979) as cited in HSDB, 10 March 1992]. In contrast, a BCF of 24 was determined for green algae (*Chlorella fusca*) [Frietag, D. et al., Ecotoxic Environ Safety 6: 60-81 (1982) as cited in HSDB, 10 March 1992]. These BCF values indicate that bioaccumulation in aquatic organisms is not expected to be a significant fate process. Adsorption of NB to suspended solids and sediments is also not expected to be a significant environmental fate process.

A Henry's Law Constant of 2.20×10^{-5} atm-m³/mol [Lyman, W. J. et al., as cited in HSDB, 10 March 1992] for NB indicates that volatilization will be a significant transport mechanism. NB in the atmosphere will exist primarily in the vapor phase. In the atmosphere, NB will degrade primarily by photolysis. NB reacts with photochemically produced hydroxyl radicals in the vapor phase, resulting in a vapor-phase half-life of 125 days in the clean troposphere and 62 days in a moderately polluted atmosphere [Atkinson, R. et al., Environ Sci Technol 21:64-72 (1987) as cited in HSDB, 10 March 1992]. Neither dry or wet deposition are expected to be significant fate or transport processes.

NB absorbs ultraviolet light in the environmentally significant range (wavelengths greater than 290 nm), suggesting that it is susceptible to direct photolysis when exposed to direct sunlight. However, information is insufficient to determine a rate.

5.2.2.2 1,3,5-TNB

1,3,5-TNB is another nitroaromatic chemical of potential concern on igloo interior surfaces.

Adsorption coefficients (K_{oc}) of 104 and 178 have been estimated for 1,3,5-TNB based upon a log octanol/water partition coefficient of 1.18 [Hansch, C. and A. J. Leo, Medchem Project Issue No. 25 (1985) as cited in HSDB, 10 March 1992] and a water solubility of 340 mg/L [Spanggord, R. J. et al., 1980, as cited in HSDB, 10 March 1992]. These K_{oc} values suggest moderate to high mobility in soil and low adsorption to suspended solids and sediments.

BCF values of 5 and 23 have been estimated based upon the above K_{oc} and water solubility parameters. These BCF values suggest that 1,3,5-TNB would not significantly bioaccumulate in aquatic organisms [Kenaga, E. E., Ecotoxic Environ Safety 4: 26-38 (1980) as cited in HSDB, 10 March 1992].

1,3,5-TNB on soil surfaces may be subject to photolysis when exposed to direct sunlight. Volatilization from soil surfaces is predicted to be an insignificant fate process. Insufficient information is available to predict its biodegradation potential in soil [HSDB, 10 March 1992].

If released to surface water, 1,3,5-TNB may be subject to photolysis when exposed to direct sunlight. Bioaccumulation in aquatic organisms and volatilization are not expected to be environmentally important fate processes. 1,3,5-TNB is predicted to exhibit moderate to low adsorption to suspended solids and sediments [HSDB, 10 March 1992].

The extrapolated vapor pressure of 1,3,5-TNB is 3.20×10^{-6} mm Hg at 20°C [Spangford, R. J. et al., 1980, as cited in HSDB, 10 March 1992]. A Henry's Law Constant of 3.03×10^{-9} atm-m³/mol has been estimated [Hine, J. and P. K. Mookerjee, J Org Chem 40: 292-8 (1975) as cited in HSDB, 10 March 1992]. Based upon this Henry's Law Constant, volatilization is not expected to be a significant environmental transport or fate process. Based upon these values, 1,3,5-TNB tends to exist partially in the vapor phase and partly adsorbed onto particulate matter in the atmosphere. The compound may be subject to photolysis when exposed to direct sunlight. A water solubility of 340 mg/L [Spangford, R. J. et al., 1980, as cited in HSDB, 10 March 1992] suggests that wet deposition is another potential environmental fate process [Eisenreich, S. J. et al., Environ Sci Technol 15: 30-8 (1981) as cited in HSDB, 10 March 1992].

1,3,5-TNB contains chromophores which absorb ultraviolet light in the environmentally significant range (wavelengths greater than 290 nm), which suggests it may be subject to photolysis when exposed to direct sunlight [Mill, T. and W. Mabey, Environmental Exposure from Chemicals Vol. 1 (1985) as cited in HSDB, 10 March 1992]. However, information is insufficient to determine a rate.

5.2.2.3 2,4-DNT

The nitroaromatic 2,4-DNT is another chemical of potential concern in soils, and on igloo interior surfaces.

Based upon 2,4-DNT's vapor pressure of 1.1×10^{-4} mm Hg at 20°C [Spangford, R. J. et al., 1980, as cited in HSDB, 10 March 1992] and water solubility of 300 mg/L [Dunlap, K. L., 1981, as cited in HSDB, 10 March 1992], the calculated Henry's Law Constant for 2,4-DNT is 8.79×10^{-8} atm-m³/mol. This value indicates that volatilization of 2,4-DNT (or 2,6-DNT) will not be a significant transport mechanism.

If released to the atmosphere, the estimated vapor-phase half-life of 2,4-DNT (or 2,6-DNT) is 8 hours as the result of the addition of photochemically produced hydroxyl radicals to the

aromatic ring [Graphical Exposure Modeling System (GEMS), Fate of Atmospheric Pollutants (FAP), 1986 as cited in HSDB, 10 March 1992]. The water solubility of 300 mg/L suggests that wet deposition is another potential environmental fate process.

Based upon 2,4-DNT's measured log octanol/water partition coefficient of 1.98 [Graphical Exposure Modeling System (GEMS), CLOGP3 (1984) as cited in HSDB, 10 March 1992], and water solubility of 300 mg/L, a BCF of 19 has been estimated for 2,4-DNT. This BCF value suggests that 2,4-DNT would not significantly bioaccumulate in aquatic organisms [HSDB, 10 March 1992].

Based upon 2,4-DNT's measured log octanol/water partition coefficient and water solubility, a K_{oc} of 282 has been estimated for 2,4-DNT. This K_{oc} value suggests that 2,4-DNT is slightly mobile in soil [Kenaga, E. E., Ecotoxic Environ Safety 4: 26-38 (1980) as cited in HSDB, 10 March 1992], and may potentially leach to groundwater. Dinitrotoluenes (all isomers of DNT) should not hydrolyze in soils. No information on biodegradation in soil can be found; however, biodegradation may be an important fate process in soil based on the metabolism of all of the isomers of DNT in surface water in which yeast extract was added.

If released to water, 2,4-DNT or 2,6-DNT and other isomeric dinitrotoluenes are not expected to bioconcentrate in animal or plant life but may sorb (via adsorption or absorption) to sediment. Biodegradation may be an important fate process in water. Hydrolysis from water is not expected to be an important fate process. Volatilization from water is not expected to be an important transport or fate process.

The ultraviolet spectrum of 2,4-DNT in hexane extends to 380 nm, which accounts for its demonstrated susceptibility to photolysis when exposed to direct sunlight. Wavelengths greater than 290 nm are considered to be in the environmentally significant range. By analogy, the ultraviolet absorptions of other isomeric dinitrotoluenes (2,6-DNT and others) may also extend into the environmentally significant range, suggesting that they may also be susceptible to photolysis when exposed to direct sunlight [Carpenter, B. H., 1977, as cited in HSDB, 10 March 1992]. However, information is insufficient to determine a rate.

5.2.2.4 2,6-DNT

The nitroaromatic 2,6-DNT is another chemical of potential concern in soils, and on igloo interior surfaces.

Since no water solubility or vapor pressure data could be found for 2,6-DNT, no Henry's Law Constant could be calculated for 2,6-DNT. However, the vapor pressure for 2,4-DNT is $1.1 \times$

10^{-4} mm Hg at 20°C , and the calculated Henry's Law Constant for 2,4-DNT is 8.79×10^{-8} atm- m^3/mol . These values indicate that volatilization of 2,4-DNT or 2,6-DNT will not be a significant transport mechanism.

If released to the atmosphere, the estimated vapor-phase half-life of 2,6-DNT is 8 hours as the result of the addition of photochemically produced hydroxyl radicals to the aromatic ring [Graphical Exposure Modeling System (GEMS), Fate of Atmospheric Pollutants (FAP), 1986 as cited in HSDB, 10 March 1992]. The water solubility of 300 mg/L for 2,4-DNT suggests that wet deposition is another potential environmental fate process for 2,6-DNT.

Based upon 2,6-DNT's estimated log octanol/water partition coefficient of 1.72 [Graphical Exposure Modeling System (GEMS), CLOGP3 (1984) as cited in HSDB, 10 March 1992], a BCF of 12 has been estimated for 2,6-DNT [HSDB, 10 March 1992]. This BCF value suggests that 2,6-DNT would not significantly bioaccumulate in aquatic organisms.

Based upon 2,6-DNT's estimated log octanol/water partition coefficient, and 2,4-DNT's water solubility of 300 mg/L, a K_{oc} of 204 has been estimated for 2,6-DNT. This K_{oc} value suggests that 2,6-DNT is slightly mobile in soil [Kenaga, E. E., Ecotoxic Environ Safety 4: 26-38 (1980) as cited in HSDB, 10 March 1992], and may potentially leach to groundwater. Dinitrotoluenes (DNT) should not hydrolyze in soils. No information on biodegradation in soil can be found; however, biodegradation may be an important fate process in soil based on the metabolism of all of the isomers of DNT in surface water in which yeast extract was added.

If released to water, 2,6-DNT and all other isomeric dinitrotoluenes are not expected to bioconcentrate in animal or plant life but may sorb (via adsorption or absorption) to sediment. Biodegradation may be an important fate process in water. Hydrolysis from water is not expected to be an important fate process. Volatilization from water is not expected to be an important transport or fate process.

The ultraviolet spectrum of 2,4-DNT in hexane extends to 380 nm, which accounts for its demonstrated susceptibility to photolysis when exposed to direct sunlight. Wavelengths greater than 290 nm are considered to be in the environmentally significant range. By analogy, the ultraviolet absorptions of 2,6-DNT and other isomeric dinitrotoluenes may also extend into the environmentally significant range, suggesting that they may also be susceptible to photolysis when exposed to direct sunlight [Carpenter, B. H., 1977, as cited in HSDB, 10 March 1992]. However, information is insufficient to determine a rate.

5.2.2.5 2,4,6-TNT

2,4,6-TNT is another nitroaromatic chemical of potential concern on igloo interior surfaces.

Generally, 2,4,6-TNT is not expected to hydrolyze, volatilize from water, or bioconcentrate under normal environmental conditions.

Based upon a K_{oc} of 1600, 2,4,6-TNT is expected to maintain low soil mobility and to a certain extent partition to sediments and suspended solids in the water column. Photolysis studies in water show that the rate of photolysis is directly related to increases in pH and organic matter content and increases over time as due to increased products of photolysis. Evidence also suggests that photochemical reactions of 2,4,6-TNT may play a more important role in surface soils and environmental waters than does biotransformation. The vapor-phase reaction of 2,4,6-TNT with photochemically produced hydroxyl radicals is expected to be slow, with a half-life of about 110 days.

A calculated Henry's Law Constant of 4.57×10^{-8} atm-m³/mol for 2,4,6-TNT indicates that volatilization will not be a significant transport mechanism. Based upon a vapor pressure of 1.99×10^{-4} mm Hg at 20°C [Boublik, T. et al., The Vapor Pressures of Pure Substances, 1984 as cited in HSDB, 10 March 1992], 2,4,6-TNT in the atmosphere is expected to exist almost entirely in the vapor phase [Eisenreich, S. J. et al., Environ Sci Technol 15: 30-8 (1981) as cited in HSDB, 10 March 1992].

2,4,6-TNT absorbs ultraviolet light in the environmentally significant range (wavelengths greater than 290 nm), suggesting that it is susceptible to photolysis when exposed to direct sunlight. However, information is insufficient to determine a rate.

5.2.3 RADON

Radon is another chemical of potential concern in igloo, and other building, interiors.

Radon, which is produced by the decay of radium, is thought to occur naturally in most soils at an estimated 1 g radium per square mile of soil (at a depth of six inches). Most radon is physically attached to the radium bearing material, and only tiny amounts are released to the atmosphere. On the average, one part of radon is present in 1 sextillion parts of air [Weast, 1988-1989 as cited in HSDB, 10 March 1992].

The mechanism of radon release from rock, soil and other materials is not very well understood, and is probably not always the same. The main physical phenomena are recoil

and diffusion of the radon atom through imperfections of the crystalline structures of the radium bearing particle, followed by a secondary diffusion which depends on the porosity of the material [Andrews, J. N. and D.F. Wood, Applied Earth Science 81: 198-209 (1972) as cited in HSDB, 10 March 1992]. High porosity increases the diffusion rate of radon. The release rate from a material such as soil depends on its moisture content. If the moisture content is very low the radon release is decreased by the effect of re-adsorption of radon atoms on surfaces in the pores. If the moisture content increases slightly, the radon release increases up to a certain moisture content, above which the release of radon decreases again owing to a decreasing diffusion rate in water filled pores [Megromi, K., J Geophys Res 79: 3357-60 (1974) as cited in HSDB, 10 March 1992].

Radon exhalation from walls, floors, and ceilings is dependent on several factors including the radium concentrations, and the quality and thickness of any applied sealant on wall, ceiling, and floor surfaces. Radon concentrations in buildings is further influenced by the ventilation rate of a room. The ventilation rate is influenced by many activities such as wind, pressure, temperature, the opening of doors and windows, etc. On the average, radon is present in the greatest amounts in the summer, and at smaller amounts in the winter and spring. Furthermore, radon levels are generally at their maximum in the early morning and their minimum at noon or in the afternoon [IARC Monographs, 1988, as cited in HSDB, 10 March 1992].

5.3 CONTAMINANT MIGRATION

As presented on Table 6-4, chemicals of potential concern detected on igloo interior surfaces, with detection frequencies noted in parentheses, are: TRPH/TPHC (6/6); NC (133/133); NB (2/131); 1,3,5-TNB (1/131); and 2,4,6-TNT (6/131).

As presented on Table 6-2, chemicals of potential concern detected in soils at the igloos, with detection frequencies noted in parentheses, are: lead (135/135); mercury (57/135); NC (56/123); 2,4-DNT (5/136); and 2,6-DNT (1/136).

Since lead (Pb) and mercury (Hg) were not analyzed for on igloo interior surfaces but only in soils, no correlation can be determined relative to lead and mercury migration between igloo interior and igloo exterior, soil or otherwise.

Nitrocellulose (NC) was detected on igloo interior surfaces at all igloos with a reported analytical result, but was detected in less than 50% of the igloo exterior soil samples. This indicates that NC has migrated outside the igloo interiors, via either through being flushed or swept along the drainage channels or through being swept along the igloo floors to the

exteriors. Although NC was detected in surface waters in all four onsite ponds sampled, and in sediments in three out of the four onsite ponds sampled, it has not been detected in any of the stream surface water or stream sediment samples.

Nitroaromatics were detected on igloo interior surfaces (NB, 1,3,5-TNB, and 2,4,6-TNT) and in igloo exterior soils (2,4-DNT and 2,6-DNT). This indicates migration has occurred to the igloo exterior, via either through being flushed or swept along the drainage channels or through being swept along the igloo floors to the exteriors. 2,4-DNT has also been detected at one of the five loading ramps. None of the nitroaromatics have been detected during this EI in any surface water or sediment samples, neither in streams nor in ponds, indicating that once released to the exterior soil, migration to the other media examined during this EI has not occurred. The physiochemical properties of these compounds, as discussed above under Section 5.2, which indicate that they are only moderately mobile in soil, support the observed analytical results.

Other environmentally significant site features that were examined during this EI include the 5 loading ramps, the 21 ground disturbances, and the debris pile. Lead (Pb), mercury (Hg) and nitrocellulose (NC) are considered to be common chemicals of potential concern for these site features. As discussed above, 2,4-DNT has also been detected at one of the five loading ramps.

The frequencies of lead (Pb) detection at these site features are: loading ramps, detected at all 5; ground disturbances, detected at all 21; and in the debris pile, detected at all 4 sampling points. Due to its physiochemical properties as discussed above under Section 5.2, Pb tends to be tightly bound to soils. Although Pb was detected in stream surface water and sediment samples, and in pond sediment samples, it was not at levels above background ranges. Therefore, it is unlikely that Pb levels in these media are a result of migration from soils at any of the site features of environmental significance.

The frequencies of mercury (Hg) detection at these site features are: loading ramps, detected at 2 of the 5; ground disturbances, detected at 6 of the 21; and in the debris pile, detected at 2 of the 4 sampling points. Hg was also detected at 57 of the 135 igloo soil sampling locations for which analytical results were reported. Hg was not detected in any of the stream or pond surface water or sediment samples. This indicates that Hg is not migrating from soils at any of the site features of environmental significance to the other media examined during this EI.

The frequencies of nitrocellulose (NC) detection at these site features are: loading ramps, detected at 3 of the 5; ground disturbances, detected at 13 of the 21; and in the debris pile, detected at 2 of the 4 sampling points. As discussed above, NC was also detected at 56 of the 123 igloo soil sampling locations for which analytical results were reported. Although NC was

detected in sediments in 3 out of the 4 onsite ponds sampled and in surface waters of all 4 of the onsite ponds sampled, it was not detected in any of the stream sediment or stream surface water samples.

The results of the EI as discussed above indicate that igloo interior surfaces at a limited number of igloos, and soils at limited locations, show detectable levels of site-activity attributable chemicals of potential concern -- chiefly the nitroaromatics 2,4-DNT (soil only), 2,6-DNT (soil only), 2,4,6-TNT (igloo interior surfaces only), nitrobenzene (igloo interior surfaces only), and 1,3,5-TNB (igloo interior surfaces only). Soils at numerous locations also show detectable levels of lead, mercury and nitrocellulose. With the exception of nitrocellulose, lead and mercury, the results of this EI's sampling effort indicate that although the chemicals of potential concern have been released to the environment, they are not migrating from the soil media to the other environmental media examined during this EI. Nitrocellulose, a site-activity attributable chemical, has migrated to onsite pond surface waters and sediments, but has not migrated either onsite or offsite via the stream surface waters or sediments. Lead and mercury in the environmental media at the site can not be conclusively attributed to site activities.

TABLE 5-1

PHYSIOCHEMICAL PROPERTIES OF
ORGANIC CHEMICALS OF POTENTIAL CONCERN
COOSA RIVER STORAGE ANNEX ENVIRONMENTAL INVESTIGATION

CHEMICAL OF POTENTIAL CONCERN	WATER SOLUBILITY (mg/L @ 20 C)	VAPOR PRESSURE (mm Hg @ 20 C)	HENRY'S LAW CONSTANT (atm - m ^ 3/mol)	LOG		SOIL/ WATER PARTITION COEFFICIENT (Koc)	VAPOR PHASE HALF-LIFE	BIO - CONCENTRATION FACTOR (BCF)
				OCTANOL/WATER PARTITION COEFFICIENT (Kow)	SOIL/ WATER PARTITION COEFFICIENT (Koc)			
Nitrobenzene (NB)	N.A.	N.A.	2.20E-05	N.A.	30.6, 42.8, 69.6, 170, 200, 370	62 - 125 days	6, <10, 15, 24	
1,3,5-TNB	340	3.20E-06	3.03E-09	1.18	104, 178	N.A.	5, 23	
2,4-DNT	300	1.1E-04	8.79E-08	1.98	282	8 hrs	19	
2,6-DNT	N.A.	N.A.	N.A.	1.72	204	8 hrs	12	
2,4,6-TNT	N.A.	1.99E-04	4.57E-08	N.A.	1600	110 days	N.A.	

6.0 BASELINE RISK ASSESSMENT

6.1 INTRODUCTION

As part of Task Order No. 4 under contract DAAA15-90-D-0013 from USATHAMA, the EI Contractor has been requested to complete a risk assessment for the Coosa River Storage Annex (the Annex) prior to its closure and transfer for other use.

To accomplish this task, the information gathered during the EI at the Annex has been critically reviewed, evaluated and utilized in general accordance with the U.S. Environmental Protection Agency's (U.S. EPA's) Risk Assessment Guidance for Superfund, Volumes I (Parts A, B, and C) and II [U.S. EPA, 1989a,b and 1991a,b]. It is emphasized that the Coosa River Storage Annex is not a Superfund site. However, assessing the potential risks associated with the site in a manner consistent with current U.S. EPA Superfund guidance allows for ready interpretation of the results and assures that the risk assessment will withstand close scrutiny.

6.2 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN FOR HUMAN HEALTH AND THE ENVIRONMENT

Analytical data utilized for this risk assessment were obtained in accordance with the approved Quality Control Plan [Jacobs, 1991], which in turn was based on the Draft Final Sampling Design Plan [Dames & Moore, 1990]. Chemical analyses of samples collected in accordance with this plan were performed by the Contract Laboratory Analytical Support Services (CLASS) laboratory under contract directly to USATHAMA. Conformance with laboratory data quality assurance/quality control criteria was verified by the laboratory Quality Assurance Coordinator (LQAC) for the CLASS laboratory prior to submission to the USATHAMA Installation Restoration Data Management Information System (IRDMIS). Analytical data used to select chemicals of potential concern were obtained directly from the IRDMIS by the EI Contractor.

Identification of the chemicals of potential concern is accomplished by following steps outlined below and illustrated on Figure 6-1. Many of the steps required in this process were performed by the CLASS laboratory during the Environmental Investigation and are only summarized below.

6.2.1 SUMMARY OF DATA EVALUATION PROCESS

Analytical data resulting from the Environmental Investigation at the Coosa River Storage Annex was obtained through IRDMIS. Prior to entry into the IRDMIS, QA/QC procedures were reviewed by the CLASS laboratory QAC (LQAC) for compliance with the USATHAMA-approved analytical methods and performance standards (Step 1, Figure 6-1).

The CLASS laboratory then entered the data for acceptance into the IRDMIS (Step 2, Figure 6-1). Not all data entered by the CLASS laboratory is acceptable. For example, data considered to be unusable due to gross quality control exceedances during analysis is not accepted by IRDMIS. Quality Assurance Status Reports which contain discussions of general data quality by lot number and spike sample recoveries were sent to both USATHAMA and the EI Contractor. These reports indicate whether data have been accepted or rejected by the IRDMIS and also indicate flagging codes that are used in judging the usability of data for quantitative risk assessment.

EI analytical data obtained from the IRDMIS were organized by medium (Step 3, Figure 6-1). Media included soil, streams (surface water and sediment), ponds (surface water and sediment), and building interiors (air and surfaces). Soil samples were further sorted according to whether they were obtained from areas in front of igloos, the debris pile, loading ramps, or ground disturbances. These data are presented in Appendices C through L of this report.

Chemicals positively detected in at least one sample from any environmental medium at the site were identified, and further characterized as either being present at elevated concentrations, or as being present but not at elevated concentrations. This was done by evaluating the detection limits (DLs) for each chemical analyzed in each sample; by evaluating the flagging codes associated with data values using criteria outlined in the IRDMIS User's Guide (Version 1991.3); and by comparing values with background ranges, where available. Chemicals that were not detected in any samples from any medium were eliminated from further consideration in the risk assessment at this point. As noted on Figure 6-1 (Step 4), the outcome of this process was a set of chemicals present at elevated levels (by medium) along with the concentrations at which they were present. It should be noted that some chemicals may be retained as chemicals of potential concern at this point even if they are not present above background levels if high DLs are reported or if their presence is considered to be of possible human health or environmental concern (e.g., carcinogens).

The frequencies of detection of chemicals in each medium were then reviewed, as noted on Figure 6-1 (Step 5). Frequency of detection is the number of total detections in the numerator over total number of analytical samples in the denominator. Data from duplicates and

replicates are considered to represent the same analytical sample. Chemicals detected only once in one or two different media may be sampling or analytical artifacts and not related to site operations or disposal practices. Except for those which are especially toxic (e.g., carcinogens), they may be ruled out as chemicals of potential concern at this point.

The positively detected chemicals in each medium were then reviewed to identify chemicals which could potentially result in adverse human health or environmental effects (Step 6, Figure 6-1). This was done by comparing detected levels with risk-based Preliminary Remediation Goals (PRGs) or with other health-based criteria where possible.

PRGs reflect concentrations of contaminants in environmental media that are highly unlikely to be associated with adverse health effects under defined, conservative, exposure scenarios. They were derived in accordance with current U.S. EPA guidance [U.S. EPA, 1991a,c]. PRGs used for comparison at the Coosa River Storage Annex were developed for residential soil exposures to the contaminants detected and are listed on Table 6-1. The assumptions used in calculating the residential scenario soil PRGs include the assumption that an individual will be exposed to the soil on the site via ingestion for a total of 30 years and that all soil normally ingested each day would come from areas of contaminated soil. This assumption results in a calculated PRG that is highly conservative -- i.e., highly likely to be lower than a level that would actually result in adverse effects at the Annex.

PRGs were not developed for chemicals detected on surfaces in building interiors since potential exposures to these compounds would be highly specific to the activities likely to occur within the specific buildings in which they were detected. Instead, all chemicals detected on interior building surfaces were selected as chemicals of potential concern, with the exception of those which would not be likely to result in toxicity. The only compound which was analyzed for in interior building air is radon. Concentrations of radon were compared to a health-based action level established by USATHAMA rather than a calculated PRG.

Chemicals known to be nontoxic in humans were also eliminated from further consideration as chemicals of potential concern for the human health evaluation at this point regardless of the concentration or frequency with which they were detected.

Determination of chemicals of potential environmental concern includes consideration of frequency of detection in environmental media and location of contaminated media, in light of overall ecotoxicity and potential for significant adverse ecological effects. As stated earlier, infrequently detected contaminants may represent sampling or analytical artifacts, or may simply indicate levels of contamination at relatively few locations. Either way, such infrequently detected contaminants pose little risk to ecosystems. Admittedly, the presence of a contaminant may have an adverse biological effect on various organisms at the microhabitat

level. However, minor biological aberrations at few locations within a system do not constitute an ecological risk, especially in the absence of sensitive or keystone ecological elements. Infrequently detected contaminants were therefore removed from further consideration as contaminants of potential environmental concern, unless the contaminant exhibits high ecotoxicity.

The location of contaminated media was also a factor in determining contaminants of potential environmental concern. The overall design of the sampling strategy targeted the locations most likely to exhibit contamination. Some of the locations at which contamination was detected have a low degree of accessibility to biota. Contaminants detected only on interior building surfaces, therefore, were removed from further consideration. Although various organisms are typically present inside the igloos (e.g., snakes and insects), the overall contribution to ecological risk of contaminants detected inside igloos is assumed to be negligible.

6.2.2 CHEMICALS OF POTENTIAL CONCERN BY MEDIUM

6.2.2.1 Soil

During the Environmental Investigation, surficial soil samples from the areas at the entrance to igloos, a debris pile, loading ramps and ground disturbance areas at the Coosa River Storage Annex (Figure 3-1) were analyzed for lead, mercury, nitroaromatics/explosives, BETX (benzene, ethylbenzene, toluene, xylenes) and TRPH (total recoverable petroleum hydrocarbons). Compounds not detected in any soil sample were eliminated from further consideration. The frequencies of detection and the range of detected concentrations of compounds that were detected are listed on Table 6-2.

Lead was detected above the background range in all categories of soil samples collected and was selected as a chemical of potential concern for igloo, debris pile and loading ramp soil. It was not selected as a chemical of potential concern for ground disturbance samples, since the levels detected were very close to background. Other detected compounds present above background and/or above risk-based PRGs in soil are 2,4-dinitrotoluene (2,4-DNT) and 2,6-dinitrotoluene (2,6-DNT). These compounds were detected in soil samples from areas in front of five and one igloos, respectively. 2,4-DNT was also detected once in soil obtained from a loading ramp.

Nitrocellulose was detected above background levels in all categories of soil samples, but is not considered a chemical of potential concern because it is inert and nontoxic [Ryon, 1986; U.S. EPA, 1987a]. Low levels of methylbenzene (toluene) were detected in two debris pile

samples, but it is not selected as a chemical of potential concern because the levels detected are markedly below the residential PRG. Methylbenzene is not selected as a chemical of potential environmental concern, either, due to low levels and short environmental persistence.

6.2.2.2 Streams and Ponds

The frequencies of detection and the range of detected concentrations of the compounds detected in streams and ponds are listed on Table 6-3. Surface water and sediment samples were obtained from ten on-site stream locations and from four pond locations on-site and one background off-site pond location as noted on Figure 3-1. Lead in stream surface water and stream and pond sediments is selected as a contaminant of potential environmental concern, due to its toxicity to aquatic organisms. No chemicals of potential concern to human health were identified.

6.2.2.3 Building Interiors

The interior air of 14 igloos was analyzed for radon and radon daughters using an alpha track detector; and the interior surfaces of six igloos were analyzed for the presence of polychlorinated biphenyls. Interior surfaces of almost all igloos were analyzed for the presence of nitroaromatics/explosives and nitrocellulose. The frequencies of detection and the range of detected concentrations of the compounds detected are listed on Table 6-4.

As indicated, radon is identified as a chemical of potential concern in interior air since it was detected above the US Army's (US Army, Radon Protocol for Base Closure) action level and the U.S. EPA's recommended upper level of exposure in homes of 4 pCi/L [DeLuca and Castronovo, 1988 cited in ATSDR, 1990].

Chemicals identified as chemicals of potential concern on interior surfaces include nitrobenzene (NB), 1,3,5-TNB and 2,4,6-TNT which were detected on the interior surfaces of two, one and six igloos, respectively.

6.2.3 SUMMARY OF CHEMICALS OF POTENTIAL CONCERN

The chemicals of potential concern for both the human health and the environmental evaluation are summarized by media/matrix on Table 6-5.

Lead was detected most frequently, being identified as a chemical of potential concern in soil obtained from areas in front of igloos, from the debris pile, and from the loading ramps. The nitroaromatics 2,6-DNT and 2,4 DNT were also detected at elevated levels in soil, but in only one and five igloo samples, respectively. 2,4-DNT was also detected at a single loading ramp location.

Radon is a chemical of potential concern in building interior air. It was detected at elevated concentrations in the interior of all the igloos in which it was analyzed for except for one. Nitrobenzene, 1,3,5-TNB and 2,4,6-TNT are chemicals of potential concern on interior building surfaces even though they were detected infrequently.

Lead is the only contaminant retained for further consideration as a chemical of potential environmental concern, primarily because it appears to be a ubiquitous contaminant at the site. The ecotoxicity of lead in the environment is well documented. Avifauna abundance can decrease as a result of primary or secondary poisoning due to ingestion of lead. Lead in soils can cause growth inhibition in plants. All phyla of aquatic biota can be affected by lead in water and sediments, although the toxic effects are modified significantly by biotic and abiotic variables [Eisler, 1988]. As indicated previously, contaminants with a low frequency of detection were excluded from further consideration, as were contaminants detected only inside the igloos.

Mercury was excluded from further consideration as a chemical of potential environmental concern since it was detected at very low levels. Moreover, the highest levels of mercury were detected in soils from in front of igloos. These areas are regularly managed (i.e., vegetation is cut and/or sprayed, and gravel is occasionally replaced) and are not expected to be utilized by wildlife. Soil invertebrates, therefore, are expected to be the only organisms that may experience adverse effects. Literature reviews suggest, however, that chronic toxicity and sublethal effects are typically not expected in earthworms at the highest levels detected [Eisler, 1987].

It is emphasized that identification of a compound as a chemical of potential concern at this point does not indicate that exposure to it will result in an adverse human health or environmental effect. It simply indicates that the chemical cannot be eliminated from further consideration in the risk assessment based on the criteria discussed in this section.

6.3 TOXICITY ASSESSMENT

6.3.1 ELEMENTS OF A TOXICITY ASSESSMENT

The purpose of a toxicity assessment is to weigh available evidence regarding the likelihood that chemicals of potential concern may cause adverse health effects in exposed humans or biota, and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood and/or severity of these adverse effects.

The toxicity assessment for the Coosa River Storage Annex was accomplished in two steps: (1) hazard identification, and (2) dose-response evaluation. Hazard identification involved determining whether exposure to a chemical of potential concern was likely to cause an increase in the incidence or severity of an adverse human health or environmental effect. This involved a review of toxicological data available for each chemical of potential concern and the preparation of a toxicological profile.

Dose-response evaluation is the process of evaluating the toxicity information and quantitatively characterizing the relationship between the level of exposure (dose) to the chemical and the incidence or severity of adverse human health or environmental effects that may result. As a result of this evaluation, toxicity values are derived that are used to estimate the likelihood of adverse effects occurring under selected exposure scenarios. For most of the chemicals of potential human health concern at the Coosa River Storage Annex, this evaluation has been performed by the U.S. EPA and summarized in the U.S. EPA's Integrated Risk Information System (IRIS) database.

For chemicals of potential environmental concern, available toxicological information was obtained from toxicological literature. Specifically, information was derived from the Synoptic Review for Lead Hazards to Fish, Wildlife, and Invertebrates, published by the U.S. Fish and Wildlife Service [Eisler, 1988].

6.3.2 HUMAN HEALTH EVALUATION

6.3.2.1 Toxicity Information for Noncarcinogenic Effects

For chemicals with noncarcinogenic toxic effects, U.S. EPA's Environmental Criteria and Assessment Office (ECAO) completes a hazard identification and dose-response evaluation and develops a reference dose (RfD). The RfD is an estimate of an exposure level that is likely to be without an appreciable risk of adverse health effects over a specified time of exposure. It is derived from a critical study (or studies) in which a dose causing an adverse

effect is identified as either having no effect (a no-observed-adverse effect level, NOAEL) or a minimal effect (a lowest-observed-adverse effect level, LOAEL). The identified dose is then modified using uncertainty factors to account for possible variability in toxic responses between animals and humans; to account for variability in sensitivity to toxic chemicals among humans; to account for uncertainty in extrapolating from experimental results observed in subchronic studies to possible chronic environmental exposures; and/or, to account for uncertainty in identifying a threshold dose (or NOAEL) from experimental data.

RfDs are expressed in various ways, principally according to the length (e.g., chronic, subchronic) and route of exposure (e.g., oral, dermal, inhalation) being evaluated. Chronic RfDs reflect a level of exposure that would not result in adverse effects when experienced for seven years to a lifetime. Chronic RfDs are used in this risk assessment to characterize risks under the conditions of exposure of a residential scenario and under the conditions of exposure of a commercial/industrial scenario when the exposure is anticipated to be for 10 years. Subchronic RfDs reflect a level of exposure that would not result in adverse effects when experienced for two weeks to seven years. Subchronic RfDs are used in this risk assessment to characterize risks under the conditions of exposure of a commercial/industrial scenario when exposure is anticipated to be for one or five years. Acute RfDs reflect a level of exposure that would not result in adverse effects if experienced for a period less than two weeks.

Reference doses established by U.S. EPA's ECAO (expressed as mg/kg-day) for each chemical of potential human health concern identified at the Annex are presented on Table 6-6.

6.3.2.2 Toxicity Information for Carcinogenic Effects

For chemicals that have carcinogenic effects, U.S. EPA assumes that a small number of molecular events can lead to uncontrolled cellular proliferation resulting in the development of cancer. This implies that there is no threshold for carcinogenic effects and that any level of exposure to a carcinogen will result in some finite possibility of developing cancer. No dose or level of exposure is considered to be risk-free. Rather than estimating a threshold dose for effects and applying uncertainty factors to derive an RfD, U.S. EPA estimates the mathematical relationship between level of exposure to the carcinogen and the probability (or risk) that cancer will result.

A number of mathematical models and procedures have been developed to extrapolate from carcinogenic responses observed at high doses of exposure used in experiments to responses expected at low doses of exposure which occur in the environment. After the data are fit to

the appropriate mathematical model, the upper 95th percent confidence limit of the slope of the resulting dose-response curve in the low dose range is calculated. This toxicity value is termed the slope factor and represents an upper 95th percent confidence limit on the excess probability of carcinogenicity per unit intake ($\text{mg}/\text{kg}\cdot\text{day}^{-1}$) of a chemical over a lifetime. Risk per unit intake of the chemical is highly unlikely to exceed the slope factor and is very likely to be less.

The risk of developing cancer as a result of exposure to carcinogens is also expressed as a unit risk. This toxicity value represents a risk per unit concentration in the particular medium contacted over a lifetime. Unit risks are expressed as $(\text{ug}/\text{m}^3)^{-1}$ for inhalation exposures or $(\text{ug}/\text{L})^{-1}$ for oral exposures. A unit risk in the range of 1×10^{-4} to 1×10^{-6} implies that an individual has between a 1 in 10,000 and a 1 in 1,000,000 chance of developing cancer in excess of a background incidence if exposed to $1 \text{ ug}/\text{m}^3$ air or $1 \text{ ug}/\text{L}$ water of a carcinogenic chemical for a lifetime.

U.S. EPA also assigns carcinogenic chemicals to weight-of-evidence classification categories which indicate how convincingly available evidence suggests that exposure to that chemical will cause cancer in humans. The weight-of-evidence categories are as follows:

<u>Group</u>	<u>Description</u>
A	Human Carcinogen
B	Probable Human Carcinogen <ul style="list-style-type: none">o B1 - limited evidence of carcinogenicity in humanso B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans
C	Possible Human Carcinogen <ul style="list-style-type: none">o limited evidence of carcinogenicity in animals or lack of human data
D	Not Classifiable as to Human Carcinogenicity
E	Evidence of Noncarcinogenicity for Humans

The weight-of-evidence classification is an important, additional toxicity value used in the toxicity assessment of carcinogens. Cancer slope factors, unit risk factors and weight-of-evidence classifications for the carcinogens identified as chemicals of potential concern at the Coosa River Storage Annex are noted on Table 6-7.

6.3.2.3 Summary of Toxicity of Chemicals of Potential Concern

Toxicological profiles for each chemical of potential concern, except nitrobenzene, lead and radon, have been prepared for USATHAMA by the Health and Safety Research Division at Oak Ridge National Laboratory. Toxicological profiles of lead and radon have been developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and a toxicological profile of nitrobenzene has been prepared by the EI Contractor. Very brief summaries of the primary toxic effects associated with these chemicals are presented below.

6.3.2.3.1 Lead (Pb)

Lead (Pb) is a naturally occurring bluish-grey metal found in small amounts in the earth's crust and occurs naturally in plants and animals used for food and in air, drinking water, rivers, lakes, oceans, dust, and soil. At the Coosa River Storage Annex lead was detected in all categories of surface soils.

Lead is absorbed by both the gastrointestinal and respiratory tract but the primary site of lead absorption in children, who are the most sensitive subpopulation for lead toxicity, is the gastrointestinal tract (GI tract). Approximately 50% of ingested lead is absorbed by children compared to 8-15% in adults [Hammond, 1982; Chamberlain et al., 1978 cited in ATSDR, 1992]. Dermal absorption of lead is much less significant. Once in the body, lead is distributed primarily to the bone, blood, and soft tissue regardless of the route of absorption.

Chronic lead toxicity is evident principally in three organ systems: the red blood cells and their precursors, the central and peripheral nervous system, and the kidneys. Lead has also been shown to have adverse effects on reproduction in both males and females [Stowe and Goyer, 1971 cited in ATSDR, 1992] and has been shown to be a relatively weak carcinogen at high doses in several animal species [Kazantasis, 1981; U.S. EPA, 1989d cited in ATSDR, 1992].

Major concerns about the presence of lead in the environment derives from its demonstrated effect on the developing nervous system. Chronic childhood exposure to lead has been shown to cause subtle and long-term deficits in intelligence, behavior and school performance [Needleman et al., 1979; Winneke et al., 1981; Yule et al., 1981; McMichael et al., 1988 cited in ATSDR, 1992]. A review of studies evaluating the effects of absorbed lead on children's cognitive skills expressed in forms of IQ has indicated that there is an association between neuropsychologic deficits and low level lead exposures in children which result in blood lead levels ranging to as low as 30-50 ug/dL [U.S. EPA, 1986a cited in ATSDR, 1992]. The magnitude of average observed IQ deficits appears to be approximately 5 points at mean blood

lead levels of 50-70 ug/dL and about 4 points at mean blood lead levels of 30-50 ug/dL. Although such IQ deficits are relatively small on average, such shifts in the mean can make a substantial difference in the percentage of children with IQ's in the extremes of population distribution (i.e., below 80 and above 125) and may impact the intellectual development, school achievement, and social behavior of the affected children sufficiently so as to be regarded as adverse. Moreover, more recent information and an evaluation of older data suggest that cognitive deficits can be associated with blood lead levels much lower than previously thought [ATSDR, 1992].

There is ample evidence for carcinogenicity of lead in experimental animals. However, available human data are inadequate to prove or disprove the carcinogenicity of lead. A preliminary assessment of lead carcinogenicity by U.S. EPA [1989c cited in ATSDR, 1992] concludes that available evidence supports lead's classification as a B2 carcinogen (probable human carcinogen). The U.S. EPA has not developed a slope factor for lead.

6.3.2.3.2 Nitrobenzene (NB)

Nitrobenzene (NB) is a high-boiling, low-reactive solvent that is readily soluble in most organic solvents and miscible in ether, benzene or ethanol. It is an oily, volatile liquid, yellow in color with a bitter almond odor [Bieber, H. H. and A. G. Hill, 1952 cited in Beauchamp et al., 1982]. At the Coosa River Storage Annex it was detected on interior building surfaces of ten igloos.

Nitrobenzene is readily absorbed through human skin and by the lungs. Absorption through skin occurs whether nitrobenzene is present in vapor or liquid form [Beauchamp et al., 1982]. Once absorbed it is metabolized to p-nitrophenol and p-aminophenol which are excreted in the urine [Ikeda, M. and A. Kita, 1964 cited in Beauchamp et al., 1982]. Animal studies have indicated that nitrobenzene is also well absorbed by the gastrointestinal tract [Robinson et al., 1951 cited in Beauchamp et al., 1982].

The most frequently reported consequences of exposure to nitrobenzene is methemoglobinemia (an increase in the amount of methemoglobin in the blood which decreases the ability of red blood cells to provide oxygen to tissues). Infants appear to be particularly sensitive to nitrobenzene-induced methemoglobinemia [Beauchamp et al., 1982]. Nitrobenzene exposure is also associated with the production of Heinz bodies in red blood cells. These are intracellular globin or hemoglobin precipitates that arise from the denaturation of hemoglobin or the abnormal synthesis of globin. There is also evidence that nitrobenzene (and/or its metabolites) is directly toxic to bone marrow and lymphoid organs in both humans and animals.

Neurotoxicity following human exposures to nitrobenzene has also been reported. Neurotoxic symptoms after acute exposures have been reported to include headache, confusion, vertigo, nausea, loss of cognition, hyperalgesia, paresthesia and polyneuritis and following experimental animal exposures have been reported to include nystagmus, paralysis, hypersensitivity, tremor, loss of righting reflex and coma. Neuropathologic lesions reported include degenerative changes in the Purkinje cells of the cerebellum and marked vacuolization of the cerebellar peduncle and medulla.

Other toxic effects include hepatotoxicity in animals and humans characterized by enlarged and tender liver, icterus, altered serum chemistry, hyperbilirubinemia and decreased prothrombin activity. Histopathological lesions following nitrobenzene exposure include cloudy swelling, fatty degeneration, destruction of parenchymal cells and slight hyperplasia of liver connective tissue [Yamada, Y. 1958 cited in Beauchamp et al., 1982]. Other miscellaneous toxic effects following nitrobenzene exposure include: degenerative changes in adrenal glands in rabbits exposed to nitrobenzene subcutaneously [Yamada, Y., 1958 cited in Beauchamp et al., 1982]; pulmonary lesions in humans following ingestion of approximately 100 mL nitrobenzene [Burminstrov, V. 1967 cited in Beauchamp et al., 1982]; degenerative testicular lesions in rats exposed to single oral doses of nitrobenzene [Bond, J. et al., in press, cited in Beauchamp et al., 1982]; and contact dermatitis in humans contacting nitrobenzene in cutting oils [Schwartz, L., 1941; 1942 cited in Beauchamp et al., 1982].

There are no data indicating that nitrobenzene is a carcinogen in either humans or animals. The U.S. EPA has established a chronic RfD of 5×10^{-4} mg/kg-day for nitrobenzene based on the observation of hematologic, adrenal, renal and hepatic lesions in rats and mice exposed via inhalation.

6.3.2.3.3 1,3,5-TNB

1,3,5-Trinitrobenzene (1,3,5-TNB), a dimorphic crystalline solid, is a Class A explosive that is less sensitive to impact, but more powerful than 2,4,6-TNT [Budavaro et al., 1989; Fedoroff et al., 1962 cited in USATHAMA, 1991c]. It has also had limited use in the vulcanization of rubber [Barnhart, 1981 cited in USATHAMA, 1991c]. At the Coosa River Storage Annex it was detected in surface soil samples from locations in front of only two of 136 igloos on-site. It was also detected on interior building surfaces in nine of the 131 igloos in which wipe samples of interior surfaces were obtained.

Most of the toxicity information derived for 1,3,5-TNB is by analogy to the structurally similar compounds 1,3-DNB and 2,4,6-TNT. Little is known about the absorption, distribution,

metabolism, and excretion of 1,3,5-TNB; however, both 1,3-DNB and 2,4,6-TNT are extensively absorbed following oral exposure and are distributed to the liver, kidney, lung, and spleen [Parke, 1961; El-hawari et al., 1981 cited in USATHAMA, 1991c].

Munition workers exposed to 1,3,5-TNB have developed skin irritation, liver damage, and anemia [Hathaway, 1977; Morton et al., 1976; Stewart et al., 1945 cited in USATHAMA, 1991c]. Animal studies have shown that oral treatment with structurally similar 1,3-DNB or 2,4,6-TNT induces anemia and increases methemoglobin concentration. These compounds also induce liver and spleen hypertrophy, and induce degeneration of the germinal epithelial lining of the seminiferous tubules resulting in decreased spermatogenesis [Cody et al., 1981; Levine et al., 1983; Furedi et al., 1984a,b cited in USATHAMA, 1991c].

On the basis of increased spleen weights in rats following treatment with 1,3-DNB in their drinking water, the U.S. EPA has assigned a chronic reference dose (RfD) of 5.0×10^{-5} mg/kg-day for 1,3,5-TNB [IRIS, 3/92]. The RfD was derived from a no-observed-adverse-effect-level (NOAEL) of 3 ppm for 1,3-DNB that was converted to 0.51 mg/kg-day 1,3,5-TNB using the molecular weight ratio of 1,3,5 TNB / 1,3 DNB ($213.11/168.11 = 1.27$).

6.3.2.3.4 2,4-DNT

2,4-Dinitrotoluene (2,4-DNT) is a yellow crystalline solid and one of six possible chemical forms of dinitrotoluene (DNT). Technical grade DNT (t-DNT) is typically composed of 78% 2,4-DNT, 19% 2,6-DNT, and small amounts of 3,4-DNT, 2,3-DNT, and 2,5-DNT [Dinlap, 1978 cited in USATHAMA, 1991a]. At the Coosa River Storage Annex, 2,4-DNT was detected in surface soil at five igloo locations and at a single loading ramp location. It was also detected on interior surfaces in seven of 131 igloos on the site.

DNT's are absorbed through the gastrointestinal tract, respiratory tract, and skin in most species [U.S. EPA, 1986 cited in USATHAMA, 1991a]. Subchronic and chronic oral toxicity studies with experimental animals indicate that the blood, liver, nervous system, and reproductive system are targets affected by 2,4-DNT. The most common hematological findings are methemoglobinemia, anemia, reticulocytosis, and an increase in Heinz bodies. Hepatotoxic effects include liver discoloration and proliferative alterations of hepatocytes and bile duct epithelium. Reproductive effects consist of decreased spermatogenesis, testicular atrophy, and ovarian dysfunction [Lee et al., 1985; Ellis et al., 1979; Lee et al., 1978 cited in USATHAMA, 1991a].

The carcinogenic activity of 2,4-DNT and t-DNT has been studied in several chronic bioassays and less than lifetime studies [Leonard et al., 1987; CIIT, 1982; Ellis et al., 1979; NCI, 1978

cited in USATHAMA, 1991a]. 2,4-DNT (containing small amounts of 2,6-DNT) induced an increased incidence of hepatocellular carcinomas and subcutaneous tumors in rats and renal tumors in male mice [Ellis et al., 1979 cited in USATHAMA, 1991a]. t-DNT induced hepatocellular carcinomas in two rat studies [Leonard et al., 1987; CIIT, 1982 cited in USATHAMA, 1991a]. There is evidence that 2,6-DNT rather than 2,4-DNT is the primary hepatocarcinogen in t-DNT [Leonard et al., 1987; Popp and Leonard, 1982 cited in USATHAMA, 1991a].

Although U.S. EPA has not evaluated pure 2,4-DNT for evidence of human carcinogenic potential, the dinitrotoluene mixture (containing 2,4-DNT and 2,6-DNT) has been classified as a B2 (probable human) carcinogen [IRIS, 3/92]. A slope factor of 6.8×10^{-1} (mg/kg-day)⁻¹ has been derived by U.S. EPA for oral exposure to the dinitrotoluene mixture and is utilized for both 2,4-DNT and 2,6-DNT in this risk assessment. The drinking water unit risk for 2,4-DNT is 1.9×10^{-5} (ug/L)⁻¹.

6.3.2.3.5 2,6-DNT

2,6-Dinitrotoluene (2,6-DNT) is a pale yellow crystalline solid and one of six possible chemical forms of dinitrotoluene (DNT). As noted above, technical grade DNT (t-DNT) typically contains about 19% 2,6-DNT, in addition to 2,4-DNT and small amounts of 3,4-DNT, 2,3-DNT, and 2,5-DNT [Dinlap, 1978 cited in USATHAMA, 1991b]. At the Coosa River Storage Annex, it was detected in surface soil from a single igloo location and on interior surfaces of only two of 131 igloos on the site.

DNTs are absorbed through the gastrointestinal tract, respiratory tract, and skin in most species [U.S. EPA, 1986 cited in USATHAMA, 1991b]. A significant increase in the death rate due to ischemic heart disease has been associated with chronic occupational exposure to t-DNT but generally human data regarding potential health effects of 2,6-DNT are very limited and there is equivocal evidence that potential reproductive effects (reduction of sperm counts) may occur in male workers exposed to a mixture of DNT isomers [Hamill et al., 1982; Ahrenholz, 1980 cited in USATHAMA, 1991b].

Oral subchronic toxicity studies with rats, mice and dogs indicate that the blood, liver and reproductive system are targets affected by 2,6-DNT in all three species [Lee et al., 1976 cited in USATHAMA, 1991b]. The primary hematologic effect in all three species is methemoglobinemia with sequelae such as Heinz bodies, reticulocytosis, anemia, and extramedullary hematopoiesis. Also seen in all three species is bile duct hyperplasia, decreased spermatogenesis and testicular atrophy. In addition, dogs exhibit neurotoxic effects

(incoordination, weakness, tremors, and paralysis) as well as inflammatory and degenerative kidney changes.

In a 1-year carcinogenesis bioassay, 2,6-DNT at oral doses of 7 and 14 mg/kg-day, respectively, produced hepatocellular carcinomas in 85% and 100% of male rats, respectively. t-DNT, containing about 76% 2,4-DNT and 19% 2,6-DNT, also yielded a positive hepatocarcinogenic response [Leonard et al., 1987 cited in USATHAMA, 1991b]. In another study on the effects of t-DNT, dietary doses of ≥ 14 mg/kg-day induced hepatocellular carcinomas in rats [CIIT, 1982 cited in USATHAMA, 1991b]. Initiating and promoting activities of 2,6-DNT in rat liver have also been reported [Popp and Leonard, 1982 cited in USATHAMA, 1991b].

Although U.S. EPA has not evaluated 2,6-DNT evidence of human carcinogenic potential, the dinitrotoluene mixture (containing 2,4-DNT and 2,6-DNT) has been classified as a B2 (probable human) carcinogen [IRIS, 3/92]. A slope factor of 6.8×10^{-1} (mg/kg-day) $^{-1}$ has been derived by U.S. EPA for oral exposure to the dinitrotoluene mixture and is utilized for both 2,4-DNT and 2,6-DNT in this risk assessment. The drinking water unit risk is 1.9×10^{-5} (ug/L) $^{-1}$.

6.3.2.3.6 2,4,6-TNT

2,4,6-Trinitrotoluene (2,4,6-TNT) is used as a high explosive in military armaments and as a chemical intermediate in the manufacture of dyestuffs and photographic chemicals [Sax and Lewis, 1987 cited in USATHAMA, 1992]. At the Coosa River Storage Annex it was detected on interior building surfaces in 13 of 131 igloos on-site.

TNT is absorbed through the gastrointestinal tract, skin, and lungs; is distributed primarily to the liver, kidneys, lungs, and fat; and is excreted mainly in the urine and bile [El-hawari et al., 1981 cited in USATHAMA, 1992].

The primary target organs for TNT toxicity in experimental animals following subchronic and chronic oral exposures are: liver (hepatocytomegaly and cirrhosis); blood (hemolytic anemia with secondary alterations in the spleen); and testes (degeneration of the germinal epithelium lining the seminiferous tubules). Chronic oral toxicity studies on rats have also demonstrated TNT-induced anemia and hepatotoxicity, as well as adverse effects on the kidney (hypertrophy and nephropathy) and sternal bone marrow fibrosis [Furedi et al., 1984a cited in USATHAMA, 1992]. U.S. EPA has derived a chronic oral RfD of 0.0005 mg/kg-day for 2,4,6 TNT, based on a LOAEL of 0.5 mg/kg-day for liver effects in dogs [IRIS, 3/92].

Major effects of chronic inhalation exposure to TNT in humans are anemia (decreases in hemoglobin, hematocrit and red blood cells), liver dysfunction (increases in serum lactic dehydrogenase, glutamic oxaloacetic transaminase, and bilirubin), and cataracts (lens opacities) [U.S. EPA 1989, 1990 cited in USATHAMA, 1992]. Other reported effects of TNT exposure include dermatitis, leukocytosis, neurological disorders, nephrotoxicity and possibly menstrual disorders and male impotency [Cone 1944, Zakhari and Villaume, 1978 cited in USATHAMA, 1992].

No epidemiological evidence is available showing an association between chronic TNT exposure and tumorigenicity in humans. In animal carcinogenicity studies, a significant increase in urinary bladder papillomas and carcinomas was seen in female F344 rats dosed with 50 mg TNT/kg-day for 24 months [Furedi et al., 1984a cited in USATHAMA, 1992]. This study was used by U.S. EPA to calculate a slope factor of $0.03 \text{ (mg/kg-day)}^{-1}$. TNT is classified in weight-of-evidence Group C (possible human carcinogen) [IRIS, 3/92].

6.3.2.3.7 Radon

Radon-222 is an inert, colorless, odorless and tasteless radioactive gas which occurs in nature. Radon comes from the natural breakdown (radioactive decay) of uranium and can be found in high concentrations in soils and rocks containing uranium, granite, shale, phosphate, pitchblende, and phosphates. At the Coosa River Storage Annex, radon was detected in the interior air of all igloos in which it was analyzed at levels ranging from 1.0 - 12.7 pCi/L. Indoor radon levels normally average about 1.5 pCi/L and outdoor radon levels normally range from 0.003 - 2.6 pCi/L [ATSDR, 1990].

Radon gas is a health hazard due to its radioactive transformation or decay into radioactive by-products or radon daughters. As radon decays, its by-products attach themselves to dust particles in the air. When these particles are inhaled, the radon decay products become trapped in the lungs. As these decay products break down further, they release small bursts of energy which can damage lung tissue and lead to increased risk of developing lung cancer. As with all carcinogens, the risk of developing lung cancer from exposure to radon depends upon the concentration of radon and the length of time you are exposed. Exposure to a slightly elevated radon level for a long time may present a greater risk of developing lung cancer than exposure to a significantly elevated level for a short time.

In indoor air, radon is diluted to such low concentrations that it does not usually present an elevated risk. However, once inside an enclosed space, radon can accumulate. Indoor levels depend both on a building's construction and the concentration of radon in the underlying soil. Since radon is a gas, it can move through small spaces in the soil and rock on which a structure

is built. Radon can seep into a structure through dirt floors, cracks in concrete floors and walls, floor drains, sumps, joints, and tiny cracks or pores in hollow-block walls. Radon also can enter water within provide wells and be released into a structure when water is used.

6.3.2.4 Uncertainties Related to Toxicity Information

The reference doses established for chemicals of potential concern represent a major source of uncertainty in a risk assessment. As stated earlier, an RfD is considered to be an estimate of daily exposure that is likely to be without an appreciable risk of deleterious effects during a lifetime. It is derived by the application of uncertainty factors to selected exposure levels identified in animal or human studies. Identified exposure levels are divided by these uncertainty factors to assure that the RfD will not be over-estimated. For example, an uncertainty factor of 10 is used to account for variations in human sensitivity when using data from valid human studies involving long-term exposure of average, healthy subjects. Additional uncertainty factors of 10 are applied to account for uncertainties in extrapolating from observations of toxicity in animals to predicted toxicity in humans; to account for uncertainties in identifying a threshold dose from experimental data; and, to account for uncertainties in extrapolating from subchronic to chronic studies. An additional modifying factor ranging from greater than 0 to less than or equal to 10 may be applied to reflect professional assessment of other uncertainties that may exist in the toxicity data base for a specific compound.

For all of the chemicals of potential concern at the Coosa River Storage Annex, uncertainty factors of at least 1,000 have been assigned to the RfDs, indicating that they are associated with a great deal of uncertainty. This means that the RfDs are very highly unlikely to reflect underestimations of exposures that would result in adverse health effects and most likely represent overestimations.

Also as noted previously, there is considerable uncertainty in knowing whether or not a compound is likely to be a potential human carcinogen, and at what level of exposure an increased risk of cancer may exist. This uncertainty is reflected in both U.S. EPA's "weight-of-evidence" classification for carcinogens and in the slope factors derived for carcinogens.

2,4-DNT and 2,6-DNT are classified as B2 (or probable human) carcinogens. There is no data linking exposure of humans to either of these compounds with cancer. U.S. EPA's classification is based on the development of cancer in laboratory rodents following exposure to a mixture of these compounds. There is, therefore, considerable uncertainty in assuming exposure to either of these compounds will result in cancer in humans. Furthermore, there is

evidence to suggest that 2,6-DNT, rather than 2,4-DNT is the primary carcinogen in a mixture of these compounds [Leonard et al., 1987 cited in USATHAMA 1991a,b].

This means that the uncertainty in assuming exposure to 2,4-DNT will cause cancer may be even greater than the uncertainty assuming exposure to 2,6-DNT will cause cancer. 2,4,6-TNT is classified by U.S. EPA as a C (or possible) human carcinogen, indicating that there is insufficient evidence to suggest that this compound is a probable human carcinogen. Only one animal study is available suggesting that this compound is a carcinogen in rats. Ordinarily, U.S. EPA does not require that carcinogenic risks be characterized for compounds that fall into this weight-of-evidence classification category. Any carcinogenic risk estimated to occur as a result of exposure to this compound should be viewed as highly uncertain.

There is also considerable uncertainty in identifying the exposure level that may result in elevated carcinogenic risk for specific compounds. To ensure that this exposure level will not be over-estimated, U.S. EPA uses the 95th percent upper bound of the estimated slope of the line relating exposure to the probability of developing cancer as the cancer slope factors and derives this value from the most conservative low-dose extrapolation model (the linearized multistage model). The actual slope factor may be less than this value, but is highly unlikely to be greater. Thus, the risk calculated from the slope factor provides an upper, but plausible, estimate of risk associated with an estimated level of exposure.

6.3.3 ENVIRONMENTAL EVALUATION

6.3.3.1 Toxicity Information for Environmental Effects

Information pertaining to potential environmental toxicity of contaminants detected in environmental media at the site was obtained via a literature search. It should be noted that toxicity information derived from the literature may have limited utility in characterizing a specific site, since studies in the literature generally examine the effects of exposure to a single contaminant under laboratory conditions. Such studies cannot identify the complex range of effects due to environmental conditions, characteristics of the media, and populations of species at a specific site. In addition, toxicity studies are not capable of measuring indirect ecological effects such as species diversity, rates of mortality and fecundity, rates of immigration and emigration, and spatial distribution of populations. These types of effects can ultimately alter the structure of the ecosystem in ways not necessarily predictable based only on acute or chronic toxic effects to individual organisms.

6.3.3.2 Summary of Environmental Toxicity of Chemicals of Potential Environmental Concern

The only contaminant identified as being of potential environmental concern is lead. The toxicity of lead in both aquatic and terrestrial systems is described below. In general, lead has the potential to adversely affect survival, growth, reproduction, development, and metabolism in living organisms. However, its effects are substantially modified by numerous physical, chemical, and biological variables.

6.3.3.2.1 Aquatic Toxicity

Physical parameters, such as hardness and pH, of surface waters determine the toxicity of lead in aquatic systems, primarily by regulating the bioavailability of lead. High pH and hardness generally precipitate lead out of water, and into sediments where it is less bioavailable. While no standards or criteria exist for lead concentrations in sediment, U.S. EPA Region IV has adopted Sediment Screening Values established by the National Oceanographic and Atmospheric Administration (NOAA). U.S. EPA Region IV recommends that additional investigations be conducted at these locations where contaminants exceed the Effects Range-Low Value (ER-L). The ER-L for lead in sediments is 35 ppm. Lead in sediments at the site ranged upward to 33 ppm (ug/g).

Water-borne lead is the most toxic form of lead in aquatic systems. The State of Alabama water quality criteria for lead is based on the hardness of the surface water, expressed as milligrams per liter (mg/L) of calcium carbonate (CaCO_3). At a hardness of 120 mg/L CaCO_3 , the chronic criteria for lead is 4.01 micrograms per liter (ug/L), while the acute criteria is 102.97 ug/L. Although lead is concentrated by biota from water, no significant biomagnification of lead occurs in aquatic food chains. Generally, increasing lead concentrations above 10 ug/L are expected to cause a wide variety of increasingly severe long-term effects on fish and fisheries. Lead uptake in aquatic invertebrates appears to be modified significantly by various depuration mechanisms. For example, accumulation of lead in crawfish was modified by elimination of lead through melting of the exoskeleton. While lead concentrations in freshwater aquatic snails positively correlates with the lead content of diet, a large proportion of assimilated lead is ultimately excreted in feces.

6.3.3.2.2 Terrestrial Toxicity

Uptake of lead by plants is usually limited by low availability of lead from soils. Damage to terrestrial plants with elevated lead contents is usually negligible, but varies widely among species. No strong evidence exists to indicate that terrestrial vegetation is important in food

chain biomagnification of lead. Reductions in the populations of soil invertebrate decomposers (e.g., earthworm and arthropods) have been observed at high concentrations of approximately 12,000 mg lead/kg soil. Besides simply reducing the number of soil invertebrates available as prey resources, additional effects could include some food chain contamination, especially to insectivores.

Lead in vegetation seed and invertebrates is not expected to pose a hazard to ground-foraging songbirds. In the absence of additional information, this may be extended to other ground-foraging avifauna as well. Forms of lead other than lead shot are unlikely to cause clinical signs of lead poisoning in birds, except for certain organolead compounds, which bioconcentrate in aquatic food items. Nestlings tend to be more sensitive than adults, with nestlings of altricial species (those confined to the nest for a period of time after hatching) are more sensitive than nestlings of precocial species, such as chickens, quail, ducks, and pheasant.

Effects of high levels of exposure to lead in mammals generally correlate with the effects observed in humans. However, as indicated earlier, food chain biomagnification of lead is uncommon in terrestrial communities, and most mammals at and near the site are not expected to be exposed to the high concentrations required to produce adverse biological effects. Body burdens of lead tend to be highest in insectivores (e.g., shrews), and lower in herbivores.

6.4. EXPOSURE ASSESSMENT

6.4.1 HUMAN HEALTH EVALUATION

Exposure assessment for the human health evaluation at the Annex was conducted in three major steps. First, the exposure setting was reviewed and characterized in terms of the general physical characteristics of the site and the characteristics of populations on or near the site that may contact contaminated media (Site Characterization). Second, possible current and future exposure pathways were identified and evaluated (Identification of Exposure Pathways). Third, exposure point concentrations were derived for each chemical of potential concern in each medium of concern, and chemical intakes for receptors described in selected exposure pathways were calculated (Quantification of Exposure).

To streamline the exposure assessment U.S. EPA's Supplemental Guidance to the Risk Assessment Guidance for Superfund [U.S. EPA, 1989a,b] entitled "Standard Default Exposure Factors" (SDEF Guidance) [U.S. EPA, 1991b] has been utilized. This supplemental guidance was developed by U.S. EPA to encourage a consistent approach to assessing exposures at Superfund sites when there is a lack of site-specific data or consensus on which exposure

parameter value to choose, given a range of possibilities. The exposure factors in the SDEF Guidance, when used to quantitate exposures, result in the estimation of a Reasonable Maximum Exposure (RME). The RME is defined as an exposure which results from combining upper-bound and mid-range exposure factors in intake equations so that the result represents an exposure that is protective and reasonable; not the worst possible case.

The SDEF Guidance also suggests that on a routine basis exposure scenarios be developed within the context of the following general land use classifications: residential, commercial/industrial, agricultural and recreational. Accordingly, each of these land use classifications have been evaluated for their applicability to the human health evaluation at the Coosa River Storage Annex.

Risks associated with RME exposures in a residential scenario ordinarily represent the upper limit on calculated risks for a site. If they are determined to be acceptable, there is generally no requirement to further evaluate the site. For this reason, RME exposures under the conditions of potential future residential use of the Coosa River Storage Annex were evaluated in this risk assessment when it was reasonable to assume residential-type exposures could occur. It was anticipated that if risks associated with RME exposures in a residential scenario using the standard assumptions were unacceptable, the exposure assessment could be refined so that it represents exposures that are more likely to occur at the Coosa River Storage Annex. More realistic exposures and therefore risks could then be estimated for the site.

6.4.1.1 Site Characterization

6.4.1.1.1 Physical Setting/Characteristics

The physical characteristics of the Coosa River Storage Annex are described in Section 2.0 of this report.

6.4.1.1.2 Population Characteristics (Potentially Exposed Populations)

Currently, 38 igloos at the Storage Annex are utilized by the Alabama National Guard, 38 igloos are utilized by the U.S. Army Anniston Army Depot, and 60 are vacant [USACE, 1991]. Since July 1985, Anniston Army Depot has had an agreement with Alabama National Guard to use the annex for materials-handling exercises using inert materials. Fort McClellan in Anniston, Alabama, has also used the Annex area as a training site. The area is surrounded by a fence which is patrolled every day by security personnel associated with the Anniston Army Depot to verify the integrity of the fence.

The igloos are Quonset hut-shaped concrete structures partially covered with earth exposing only the front semi-circular side and part of the roof surface. Most soil samples were obtained from each side of the front of each igloo where shallow interior drains along each side of the concrete floor exited the igloo. Individuals involved in permitted work activities are therefore the most likely potentially exposed current populations for this site. Specifically, this population includes workers associated with either the Alabama National Guard or the Anniston Army Depot who may visit the site while engaged in work-related activities.

Private individuals who gain access to the Annex may also constitute a current potentially exposed population. During the EI Contractor's ecological characterization site visit in February 1992, the Anniston Army Ammunition Depot Pest Control Manager indicated that the site was often used by hunters.

The Coosa River Storage Annex has been recommended for closure by the U.S. Army since it is viewed as having limited military value, and has been essentially inactive for several years [USACE, 1991]. If the facility is closed, it may continue to be used as a storage facility or it may be developed for other uses. The Alabama National Guard has expressed a strong interest in purchasing the Annex. Should the Alabama National Guard acquire it, the site would continue to be used for training purposes and possible future expansions in facilities and training mission. In such a case, potentially exposed future populations would be similar to current exposed populations.

If the property were to be purchased by a private entity, the relatively undeveloped portions of the site would most likely be used for timber management and, to a small extent, pastureland. Potential exposures in these areas would be minimal since they are removed from the areas of contamination which are of concern here. The igloos could be utilized by an industrial operation with a need for large storage facilities. Potential exposures in this case would be similar to exposures currently occurring.

Substantial growth of the City of Talladega in the future may result in some demand for residential development in the area. In this case, potential exposures may occur in a residential setting, although it should be emphasized that any residential development on-site would probably involve demolition and removal of the igloos, which would undoubtedly redistribute, and most likely dilute, contaminants currently in soil near the igloos.

6.4.1.2 Identification of Exposure Pathways

An exposure pathway describes the course a chemical takes from the source to the exposed individual. It is characterized by: (1) a source (the contaminated media) and mechanism of chemical release (e.g., volatilization, runoff, etc.); (2) a retention or transport medium (e.g., air, groundwater, etc.); (3) a point of potential human contact with a contaminated medium (an exposure point); and (4) an exposure route (e.g., ingestion) at the contact point. An exposure pathway is complete only when each of these elements is present. By evaluating these four components, it is possible to identify complete exposure pathways existing at the site. This section describes the most likely complete exposure pathways at the Coosa River Storage Annex after first summarizing potential sources of exposure, potential transport media (environmental fate and transport), and potential points and routes of exposure.

6.4.1.2.1 Sources of Exposure (Contaminated Media)

Surface soil, surface water, sediment and building interiors (air and surfaces) were the only environmental media studied during the Environmental Investigation. Of these, only soil and building interiors (air and surfaces) were found to contain elevated levels of chemicals of potential concern for the human health risk assessment. These media, then, are the only contaminated media and sources of exposure of concern for this risk assessment. It is noted that soil contaminants may migrate into groundwater, but consideration of groundwater contamination is not within the scope of the Environmental Investigation or this risk assessment.

6.4.1.2.2 Environmental Fate and Transport of Chemicals of Potential Concern

Chemicals of potential concern in soil are lead and the nitroaromatics 2,4-DNT and 2,6-DNT.

When lead is released into the environment, it has a long residence time compared to most other pollutants. As a result, lead and its compounds tend to accumulate in soils and sediments, where, due to their low solubility and relative freedom from microbial degradation, they will remain accessible to the food chain and to humans far into the future [Davies, 1990]. This means that the potential for exposure to lead via contact with contaminated surface soil currently exists at the Coosa River Storage Annex and will continue to exist unless contaminated soil is removed.

The nitroaromatics 2,4-DNT and 2,6-DNT exhibit moderate mobility in soil. They may therefore remain in surface soil where they may be contacted directly, while also leaching to

groundwater. These compounds are not expected to bioconcentrate in animal or plant life but may sorb (via adsorption or absorption) to sediment. Potential exposures may occur through ingestion of contaminated drinking water and from dermal and inhalation exposure of contaminated soil [Hazardous Substances Database (HSDB), 10 March 1992].

Chemicals of potential concern in building interiors are radon (in air) and the nitroaromatic compounds nitrobenzene, 1,3,5-TNB, and 2,4,6-TNT (on surfaces).

Radon is thought to occur naturally in most soils at an estimated 1 g radium per square mile of soil (at a depth of 6 inches). This, in turn, is released in tiny amounts to the environment [Weast, 1988-1989 cited in HSDB, 10 March 1992]. Radon exhalation from walls, floors, and ceilings is dependent on several factors including the radium concentration, and the quality and thickness of any applied sealant on wall, ceiling, and floor surfaces. Radon is further influenced by the ventilation rate of a room. The ventilation rate is influenced by many activities such as wind, atmospheric pressure, temperature, the opening of doors and windows, etc. On the average, radon is present in the greatest amounts in the summer, and at smaller amounts in the winter and spring. Furthermore, radon levels are generally at their maximum in the early morning and at their minimum at noon or in the afternoon [IARC Monographs, 1988 cited in HSDB, 10 March 1992]. Consequently, potential exposures to radon would be via inhalation.

The nitroaromatic compounds detected on interior surfaces were most likely present as dusts on the concrete surfaces, since they normally exist and were stored as solids. Potential exposures are most likely to be via dermal contact. During routine activities in the igloos particulates may become airborne and available for inhalation, however, this would represent a very minor pathway of exposure.

6.4.1.2.3 Exposure Points and Exposure Routes

Only complete pathways involving current or future contact with contaminated media are of concern in a human health risk assessment. Thus, exposure pathways in which (1) the potentially exposed population is not likely to experience significant contact with a contaminated medium, or (2) the environmental medium contacted is not significantly contaminated, have been eliminated from consideration. At the same time exposure pathways where (1) the potentially exposed population is likely to contact a contaminated medium, or (2) the environmental medium contacted is significantly contaminated, have been selected for evaluation.

As previously indicated, soil and building interior air and surfaces are the media contaminated at the Coosa River Storage Annex. Thus, exposure pathways that would result in the greatest potential exposures to these media have been selected for evaluation. A potential residential scenario was selected for evaluation as a complete exposure pathway since future residential development of the Coosa River Storage Annex has not been ruled out. Evaluation of residential pathways should result in the maximum estimated exposures to the chemicals of potential concern in soil and hence the maximum possible estimated risk associated with this medium. It has been assumed that if risks due to soil exposure under the conditions of a residential exposure scenario fall within an acceptable range, adverse human health effects are highly unlikely to result from contact with contaminated soil at the site regardless of any potential future use.

If the igloos remain standing, the most likely potentially exposed population are individuals (private or military) who may visit the site occasionally while engaged in storing and removing material from the storage igloos. Accordingly, potential exposures to soil, interior surfaces, and interior air of igloos have been quantified under such a scenario.

6.4.1.2.4 Complete Exposure Pathways Evaluated

Residents/Adult and Child

In order to develop an upper range of possible exposures for this risk assessment, it was initially assumed that, in the future, the Coosa River Storage Annex may be subdivided into 1,000 ft by 1,000 ft square residential plots (exposure units) approximately 23 acres in size (1,000,000 ft²) and that individuals would integrate exposure to contaminants in soil over this area. This size area was originally chosen because an area this size would include contaminant concentrations from several soil locations and average and 95th percent upper confidence limits (UCL) on the average exposure point concentrations could be derived. The division of the Coosa River Storage Annex into exposure units is shown on Figure 6-2.

Under the conditions of a residential exposure scenario, it is assumed that the buildings currently on-site would have been removed and replaced with private dwellings so that no exposures to contaminated air and surfaces in the building interiors is anticipated. It should be noted that during the demolition process and subsequent residential construction, contaminated soil, which is located primarily in close proximity to the front of the igloos, would most likely be redistributed and probably substantially diluted. Residential exposures based on the soil concentrations currently existing at the site are therefore highly likely to be overestimations.

Estimated exposures are based on the assumptions that a single individual will reside in a dwelling located within one of the exposure units from the age of 1 through the age of 30, and for the first 6 years will ingest 200 mg soil/day and for the remaining 24 years will ingest 100 mg soil/day. This is in accordance with the current SDEF guidance. Further, it is assumed that chronic dermal contact of soil will occur throughout that period. For both ingestion and dermal intake calculations, it is assumed that all soil contacted comes from a contaminated source. Quantification of exposure based on these assumptions is highly unlikely to underestimate exposures and is very highly likely to overestimate exposures.

Commercial/Industrial Workers

The most likely potential (current and future) uses for the buildings on the site are for continued storage of military munitions products and other materials. Conceivably, if the igloos remain standing, use of the site by a private storage facility operator may also be likely. Potential exposures that may occur from such use were therefore evaluated for all exposures involving building interior surfaces and interior air. Exposures to contaminated soil on-site were also included in determining total potential exposures assuming a future commercial/industrial use of the site.

Estimated exposures are based on the assumptions that a single individual may be likely to be engaged in activities around and in a specific igloo repeatedly for a period of 10, 5 or 1 years. While engaged in those activities, it is assumed that the individual always contacts soil near the entrance to the igloo via ingestion and direct dermal contact; always dermally contacts contaminated interior surfaces and always inhales contaminated interior air. Quantification of exposure based on these assumptions is highly unlikely to underestimate potential exposures that may occur under the designated use, and is more than likely to overestimate them.

6.4.13 Quantification of Exposures

Quantification of exposure involves calculation of the estimated chemical intake likely to be experienced by receptors in each of the scenarios selected for evaluation. Exposure equations are developed to determine chemical intake expressed as mg of chemical per kg of body weight per day (mg/kg-day). These equations incorporate rates of contact with contaminated media (e.g., ingestion rate, inhalation rate), duration and frequency of exposure to the contaminated medium, exposure point concentrations of each chemical of potential concern for each medium, and other exposure factors unique to each exposure scenario in estimating chronic intakes. Chemical intake equations applicable to the exposure scenarios evaluated here are summarized on Table 6-8.

Estimated chemical intakes calculated using these types of equations can be highly uncertain. Actual exposures may be less than or greater than those calculated. In order to assure that potential exposures are not underestimated, the U.S. EPA requires that a combination of upper-bound and mid-range estimates of exposure factors be used to calculate potential exposures. The resulting exposure estimate represents a "reasonable maximum exposure" or RME. In this report, the RME is calculated for each exposure scenario using upper-bound values for contact rate and exposure frequency and duration values, and average values for body weight, in accordance with the SDEF Guidance [U.S. EPA, 1991b].

Specific exposure parameters used in these chemical intake equations are unique for each scenario evaluated and are discussed below. Exposure point concentrations (i.e., concentrations of chemicals in specific environmental media) for each chemical of potential concern which are used in chemical intake calculations are listed on Table 6-9 (soil) and Table 6-10 (building interiors) and are also discussed below.

The U.S. EPA has developed a procedure for quantifying exposure to lead which differs from that described above. Instead of calculating an intake using chemical intake equations, a computer-based Uptake/Biokinetic (U/BK) Model (now in Version 5.0) is available for calculating lead exposures. The U/BK Model is a computer-based model which estimates blood lead levels (in ug lead/dL blood) for children aged 0 to 6 or 7 years, resulting from exposure to lead via a variety of different environmental media (e.g., water, air, paint, dust) under the conditions of a residential exposure scenario. Blood lead levels, which are the most sensitive measure of lead exposure, estimated by the U/BK Model are compared to 10 ug lead/dL blood established by the U.S. EPA as a blood lead level in children unlikely to result in adverse health effects [U.S. EPA, 1989d]. If the model predicts that more than 95% of exposed children may have blood lead levels exceeding 10 ug/dL, an unacceptable health risk is deemed to exist. This model is used below to quantify exposure to lead in soil.

6.4.1.3.1 Residential Scenario

Exposure factors associated with exposure to contaminants in soil via direct ingestion and dermal contact assuming residential exposures are listed on Table 6-11. Potential inhalation intakes are anticipated to be insignificant compared to ingestion and dermal intakes under the conditions of the residential scenario and so are not estimated.

To estimate contaminants in soil, the Coosa River Storage Annex site was divided into exposure units of approximately 23 acres in size as described above. It has been assumed that an individual may integrate exposure to contaminated soil within these exposure units. The

arithmetic mean and 95% upper confidence limit (95% UCL) on the mean were derived for the detected contaminants within each exposure unit in accordance with current U.S. EPA guidance [Memorandum from Exposure Assessment Group, OHEA, ORD of U.S. EPA, 26 March 1991]. Exposure point concentrations are based on all data from surface soil samples contained within the designated exposure unit. As indicated on Table 6-9, in many instances, the 95% UCL value exceeded the highest detected amount. Therefore, the highest detected concentration was utilized as the exposure point concentration. It is emphasized that this results in an estimate of exposure based on a single analytical sample. Therefore the estimate of exposure is highly uncertain. The resulting exposure estimate, however, is highly unlikely to underestimate exposure (and thus risk) and more than likely will overestimate exposure.

Nitroaromatics

Estimated chemical intakes resulting from ingestion and dermal contact of the nitroaromatics in soil under the conditions of a residential use scenario are listed on Table 6-12. Note that nitroaromatic chemicals of potential concern were detected only within the six exposure units listed on Table 6-12. The total ingestion and dermal intakes represent the sum of both childhood and adult exposure. Intakes of 2,4-DNT and 2,6 DNT were derived assuming that carcinogenicity may result from exposure to them.

Lead

Exposure point concentrations used for estimating exposures to lead are also listed on Table 6-9. The exposure unit with the highest detected level of lead, and also the highest estimated 95% UCL on the mean, is E10. Therefore, only potential exposures to lead within this exposure unit were initially quantified. It was assumed that if the risk due to lead associated with the intake calculated within this exposure unit was within an acceptable range, there would be no need to evaluate lead exposure in the remaining exposure units.

The exposure point concentration for lead in exposure unit E10, which was used to quantify exposure was the highest detected level, 680 mg/kg. This value was used in the U.S. EPA's U/BK Model (Version 5.0) to estimate blood lead levels that would result in potential future resident children. The model is limited to children because they are the most sensitive subpopulation for experiencing adverse health effects as a result of lead exposure. Geometric mean blood lead levels estimated by the model for this highest detected level of lead is 5.07 ug lead/dL blood. This value is markedly below the U.S. EPA's level of concern of 10 ug lead/dL of blood and indicates that residential lead exposures at this site are not likely to cause adverse human health effects. This is discussed further below.

6.4.1.3.2 Commercial/Industrial Scenario

Exposure factors associated with exposure to contaminants in soil and with exposure to contaminants in air or on surfaces in building interiors in the commercial/industrial setting described are listed on Table 6-13. Total contaminant intake was calculated to be the sum of exposure due to contact with soil and building interior surfaces. Exposures were calculated for each specific igloo in which contaminants were detected using the concentrations of contaminants detected at that igloo. Risk due to radon was evaluated separately.

Nitroaromatics in Soil

Estimates of intake of nitroaromatics present in soil in front of each of these igloos are listed on Table 6-14.

Estimates of exposure to contaminants in soil under the conditions of this scenario are highly likely to be overestimations for several reasons. The chemical concentrations used as exposure point concentrations in soil were derived from samples obtained in areas in front of the igloos where drainage trenches exited the structure and are therefore likely to represent small discrete areas of the most highly contaminated soil. It is highly unlikely that individuals would repeatedly contact this specific area. Furthermore, the types of activity anticipated in and around the igloo may not result in contact with soil at all. To attempt to provide a range of potential exposures to soil reflecting the uncertainty in these estimates, intakes were calculated assuming 20 days of exposure over a 1 year period (20 days total exposure), 20 days exposure over a 5 year period (100 days total exposure) and 20 days exposure over a 10 year period (200 days total exposure).

Nitroaromatics on Building Interior Surfaces

Nitroaromatics were detected on interior building surfaces in several igloos as noted on Table 6-10. Exposures were calculated for each igloo where these compounds were detected. These estimated exposures are listed on Table 6-15. Note that intakes were calculated for 2,4,6-TNT assuming that it may cause both noncarcinogenic and carcinogenic effects.

Estimates of exposure to contaminants on building interior surfaces under the conditions of this scenario are very uncertain and highly likely to be overestimations for several reasons. The chemical concentrations used as exposure point concentrations were derived from a

composite sample of four 100 cm² areas from the wall, ceiling and floor of each igloo. It is very highly unlikely that an individual would repeatedly contact each of these areas when working within an igloo. Furthermore, it is possible that if an area were contacted on one or two occasions, subsequent exposures may be less since much of the available contaminant may have been removed. To attempt to provide a range of potential exposures to contaminants on interior building surfaces reflecting the uncertainty in these estimates, intakes were calculated assuming 1, 5 or 10 years of repeated exposures as was done above for the nitroaromatics in soil.

Radon in Building Interior Air

Naturally-occurring radon was detected above the action level of 4 pCi/L in almost every igloo in which it was analyzed. Reasonable maximum exposures to radon assuming exposure conditions under a commercial/industrial scenario and exposure durations of 1, 5 or 10 years are listed on Table 6-16.

Lead in Soil

Potential exposures to lead in soil under the conditions of a commercial/industrial scenario were not calculated since the most sensitive subpopulation for experiencing adverse health effects from lead exposure are children. The commercial/industrial exposure scenario is limited to adult exposures, and adults are not expected to experience adverse health effects due to lead exposure. The potential impact of lead exposure on potential future residential children has been discussed above under Subsection 6.4.1.3.1.

6.4.1.4 Uncertainties in Exposure Assessment

There are many uncertainties in the exposure assessment in this risk assessment which involve both the identification of potentially exposed populations and the quantification of exposures.

Exposures of potential future residents to contaminated soil on-site were quantified to provide an upper limit to possible exposures that may occur. The likelihood that exposures to contaminants in soil may occur in a residential setting is highly uncertain. There are no known plans to develop the area for residential use [USACE, 1991]. Furthermore, the structures currently existing are suited for the very limited use of storage and their existence on the site enhances the probability that future use of the site would be more likely to be similar to past and current use. Moreover, if the site were developed residentially, the storage igloos would

undoubtedly be dismantled and removed. Soil contaminants detected in the surface soil immediately in front of these igloos would also undoubtedly be partially removed or redistributed and diluted in the soil matrix.

Commercial/industrial activities are anticipated to result in the most likely potential exposures to contaminated soil and/or air and surfaces in building interiors. Workers are assumed to contact contaminated soil and building interior surfaces and air while engaged in work activities. Estimates of exposure under the defined commercial/industrial exposure scenario are believed to be unlikely to underestimate potential exposure. It is emphasized, however, that current exposures are not occurring, and estimates of future exposures are uncertain.

Major additional uncertainties in quantifying exposures based on the analytical data available from the Environmental Investigation at the Annex results are due to the fact that estimated concentrations are based on a single round of samples and the fact that there is a great deal of variability in the concentrations that were detected. Because of this uncertainty, the highest detected levels of contaminants detected has most often been used to calculate exposures. The possibility that actual concentrations would be less than the levels used to quantify exposures is high. It is unlikely that actual concentrations are actually higher than those detected, since sampling activities were concentrated in areas thought to have the highest potential concentration.

Also, estimates of dermal exposure to nitroaromatics are especially uncertain. This is because these compounds are normally present as solids. If they adhere to skin, they may be likely to be brushed off before significant absorption and intake could occur. Also, the degree to which they may be likely to partition into and through the skin is unknown. In this risk assessment, it has been assumed that 80% of the dose contacted will be absorbed. This results in an estimate of dermal exposure which is much more likely to overestimate, rather than underestimate, exposure and hence risk.

The quantification of exposure always involves many uncertainties. For example, many of the exposure parameters, such as body weight or body surface area, used in calculating chemical intakes, are estimates of mean or median values. Actual values for specific individuals exposed could be less than, or greater than, those used. Many other parameters, such as residential exposure frequency and duration, are 90th and 95th percentile values. It is highly unlikely that actual values of these parameters for specific individuals exposed will exceed those used, and more likely that actual values will be less than those used. So, use of these values contributes to a maximization of estimated exposure. This, in turn, helps to assure that risk will not be underestimated.

6.4.2 ENVIRONMENTAL EVALUATION

6.4.2.1 Introduction

Environmental exposure assessment involves a determination of the extent to which biota known or assumed to occur at or utilize the site may contact contaminants present in environmental media. It focuses on identifying and describing the specific biotic components of the ecosystem which are potentially exposed to contamination at the site. Descriptions of the various habitats at the site which contain contaminated media are evaluated and a synopsis of the specific biotic components within habitats which may be exposed to contaminants present in the media is given. Special attention is paid to sensitive and important species present in each habitat. Routes of potential exposure for the biotic components at the site are then characterized and a qualitative assessment of the extent of exposure is made. This determination is based on characteristics of the chemicals of potential environmental concern in concert with characteristics of the on-site food web, including life histories and feeding habits of the biota potentially exposed.

6.4.2.2 Characterization of Exposure Setting and Populations

6.4.2.2.1 Aquatic Systems

As indicated earlier, aquatic phytoplankton and aquatic invertebrates are the only aquatic organisms identified on-site which may be exposed to lead in surface water and sediment. There is a medium potential for bioconcentration of lead from water given the typical hardness of county surface waters. The potential for uptake of lead from sediments is low in the impoundments/ponds (due to the affinity of lead for organic matter), and medium in streams. Off-site aquatic organisms which may be exposed to lead in surface water include invertebrates and piscine (fish) populations.

Exposure pathways for aquatic organisms are generally restricted to uptake as a result of direct contact and passive ingestion. Exposure due to food chain transfer is not expected to be significant. Exposure pathways for terrestrial mammals and avifauna are through direct contact with and consumption of surface water. Lead in surface water was detected in only two of ten stream samples.

6.4.2.2 Terrestrial Systems

Exposure pathways are most direct for invertebrate organisms, typically through direct contact and food chain contamination. As indicated earlier, exposure pathways for terrestrial plants, and birds and mammals are negligible, due to the low likelihood of initial uptake and subsequent food chain biomagnification.

6.4.2.3 Assessment of Exposure

Exposure to lead-contaminated media is expected to be restricted to floral and faunal elements intimately associated with each contaminated medium. The biological effects of such exposure are subsequently expected to be manifested in the exposed populations only, since there is a low likelihood of food chain effects in both aquatic and terrestrial systems. Such manifestations may include reduced survival, impaired reproduction or development, decreased abundance, and various sublethal effects. Since none of the affected populations play key roles in the ecology of the area, these manifestations are not expected to produce aberrations elsewhere within the ecosystems.

6.4.2.4 Uncertainties in Exposure Assessment

Limitations associated with development of exposure scenarios arise from limited field characterization of at-risk biotic components. Exposure scenarios are therefore based on known conspicuous biological elements, and inferred inconspicuous elements. Uncertainties in these and other evaluations also arise from the spatial and temporal transience of faunal elements of the area, and temporal transience of floral elements at the site. Uncertainties associated with the toxicity assessment include extrapolations made from species in literature reviews to on-site organisms, and extrapolations from controlled laboratory experiments to natural field conditions.

6.5 RISK CHARACTERIZATION

6.5.1 PROCEDURES FOR CHARACTERIZING HUMAN HEALTH RISKS

6.5.1.1 Noncarcinogens

The potential for noncarcinogenic effects is evaluated by comparing the exposure level, or chemical intake, over a specified time period (e.g., acute, subchronic or chronic) with a

reference dose (RfD) derived for a similar exposure period. This ratio of exposure to a reference dose is referred to as a hazard quotient.

The hazard quotient assumes there is a level of exposure (i.e., RfD) below which it is unlikely that even sensitive populations will experience adverse effects. If exposure is equivalent to or less than the reference dose the hazard quotient will be 1.0 or less, and a hazard is not likely to exist. If exposure exceeds the reference dose, the resulting hazard quotient will exceed 1.0 and a hazard may be indicated.

It is important to note that the ratios of exposure to reference doses (RfDs) do not indicate statistical probabilities. This is because there are many uncertainties involved in both the exposure estimates and the derivations of the RfDs. Hazard quotients should therefore be viewed as indicating either that a health hazard may be likely to exist (hazard quotient of 1.0 or greater) or that a health hazard is unlikely to exist (hazard quotient of less than 1.0).

A hazard quotient was derived for each noncarcinogenic chemical of potential concern specific to each exposure pathway. Hazard quotients for each chemical were summed for each exposure pathway resulting in what is termed the hazard index associated with that pathway. This practice is "conservative" since the various chemicals may affect different organ systems. Therefore, the toxic effects resulting from exposure to them simultaneously may not necessarily be additive.

Total exposure pathway hazard indices may also be summed across pathways whenever it is possible that individuals may be simultaneously exposed to contaminants via more than one pathway.

6.5.1.2 Carcinogens

For carcinogens the risk was estimated by multiplying the slope factor which indicates the risk per mg/kg-day by the estimated lifetime average daily intake.

6.5.1.3 Lead

Blood lead levels resulting from childhood exposure to lead in soil in a residential setting and estimated using the U/BK Model are compared to 10 ug/dL, which has been established by the U.S. EPA as a blood lead level unlikely to be associated with adverse health effects. If more than 5% of exposed children are likely to have blood lead levels above 10 ug/dL, soil

lead levels are considered to represent an unacceptable level of risk of experiencing adverse health effects.

6.5.2 RESIDENTIAL SCENARIO

6.5.2.1 Noncarcinogenic Risks

Neither of the nitroaromatic chemicals of potential concern in surface soil have been characterized as having noncarcinogenic effects. Therefore hazard quotients to indicate noncarcinogenic risks to potential future residents have not been developed.

6.5.2.2 Carcinogenic Risks

As noted previously, the only chemicals classified as carcinogens that were detected in surface soil are 2,4-DNT and 2,6-DNT, which were detected within only six exposure units -- B3, B4, C3, C5, C7 and D5. Risks associated with exposure to these compounds via ingestion and dermal contact with soil under the conditions of a residential scenario are indicated on Table 6-17. The total estimated carcinogenic risks range from 4.6×10^{-5} for exposure unit C3 to 4.3×10^{-3} for exposure unit B3. It should be noted though that these estimates are based on the single highest detected level of these contaminants in each of these exposure units since the 95% UCL was found to be greater than the highest detected level.

Estimates for 2,6-DNT are based on a single detection at a single igloo. As noted previously, it is very highly unlikely that an individual would experience contact with soil with this level of contamination daily for the 30 year period which has been assumed. Furthermore, there is evidence that 2,6-DNT rather than 2,4-DNT is the primary carcinogen in DNT mixtures [Leonard et al., 1987 cited in USATHAMA, 1991b], so that estimates of carcinogenic risks due to exposures to 2,4-DNT may be more highly uncertain than risks due to exposures to 2,6-DNT. For these reasons these estimates should be viewed as indicating an absolute upper limit of carcinogenic risk possibly associated with exposures to soil on this site.

6.5.2.3 Lead

According to the U/BK Model, the blood lead levels estimated to occur in children as a result of exposure to lead contaminated soil in a residential setting at the Coosa River Storage Annex is 5.07 ug/dL. As indicated on Figure 6-3, in the absence of exposure to any other lead contaminated media (e.g., water, air), 2.51% of the children exposed to the highest detected

level of lead are expected to have blood lead levels exceeding 10 ug/dL, which is within the acceptable range of 5% or less. Therefore, exposure of children to lead-contaminated soil under the conditions of exposure of the very conservative residential scenario described at the Coosa River Storage Annex does not represent an unacceptable health risk.

6.5.3 COMMERCIAL/INDUSTRIAL SCENARIO

6.5.3.1 Noncarcinogenic Risks

Hazard quotients reflecting the potential that a noncarcinogenic health hazard may result from contacting compounds detected on building surfaces under the conditions of exposure of a commercial/industrial scenario are shown on Table 6-18. No noncarcinogenic compounds (other than lead) were identified in soil.

Two nitroaromatic compounds with noncarcinogenic effects -- nitrobenzene and 2,4,6-TNT -- were detected on building interior surfaces. As indicated on Table 6-18, no exposures to building interior surfaces resulted in hazard quotients which exceeded 1.0 under the conditions of the commercial/industrial scenario described.

6.5.3.2 Carcinogenic Risks

Risks associated with exposure to 2,4-DNT and 2,6-DNT via ingestion and dermal contact with soil in front of each igloo and with exposure to 2,4,6-TNT on interior building surfaces under the conditions of exposure of the commercial/industrial scenario described are indicated on Table 6-19. These results indicate that at Igloos 1702, 2101 and 2108 the carcinogenic risk due to possible exposure to soil is greater than 1×10^{-6} when exposures are assumed to occur over a period of 10 years. When exposures are assumed to occur over a period of 5 years, only Igloo 1702 is associated with a carcinogenic risk of 1.0×10^{-6} . When exposures are assumed to occur during 1 year only, none of the igloos are associated with risks which exceed 1×10^{-6} .

Carcinogenic risks estimated to result from repeated contact with building interior surfaces are also indicated on Table 6-19. None of the igloos in which 2,4,6-TNT was detected have risks which exceed the 1×10^{-6} range for any exposure duration (1, 5 or 10 years). Furthermore, it is re-emphasized that 2,4,6-TNT is classified by U.S. EPA as a C (or a possible) carcinogen and thus any risk associated with this compound is deemed to be of less concern than potential risk associated with 2,4-DNT or 2,6-DNT.

These estimates should be viewed as representing the upper limit on estimated risk for the following reasons. Estimations of intakes of carcinogens in soil associated with each igloo are based on a single composite soil sample obtained from locations anticipated to have the highest level of contamination. Estimations of intake are also based on highly conservative exposure assumptions. 2,4-DNT and 2,6-DNT, the only compounds for which carcinogenic risk was indicated, are classified as B2, or probable human carcinogens, on the basis of evidence that a mixture of these two compounds results in carcinogenicity in laboratory rodents. The degree to which either one of these compounds may result in carcinogenicity in humans is unknown, which contributes considerable uncertainty to the risks derived in this case.

Risks due to exposure to naturally-occurring radon are indicated on Table 6-20. When an exposure duration of 5 or 10 years is assumed, most risks are in the range of 1×10^{-4} , and when an exposure duration of only 1 year is assumed, most risks are in the range of 1×10^{-5} . It is re-emphasized that the exposure scenario assumed more than likely overestimates potential exposures that may occur to a single individual over the 1-, 5- or 10-year exposures estimated. Furthermore, in the case of radon, it seems highly likely that activities in and around the storage igloos would result in ventilation of the igloos by opening the doors for extended periods of time, thus potentially decreasing concentrations in the air.

6.5.4 ENVIRONMENTAL RISK CHARACTERIZATION

As indicated previously, potential environmental risk would be restricted to those aquatic phytoplankton and aquatic invertebrates present in the streams and ponds which may be exposed to lead in surface water and sediments. While these organisms are undoubtedly at some degree of biological risk, the ecological risks associated with contaminated media at the site are negligible.

6.6 RISK SUMMARY

Noncarcinogenic human health hazards were not found to exist at the Coosa River Storage Annex.

Areas of elevated human health carcinogenic risk at the Coosa River Storage Annex were found to exist within only six exposure units -- B3, B4, C3, C5, C7, and D5. Within these exposure units, anticipated risks should be viewed as being limited to exposures to soil in areas in front of the specific igloos identified on Table 6-21. Elevated risks were not found to result from exposure to contaminants on building surfaces.

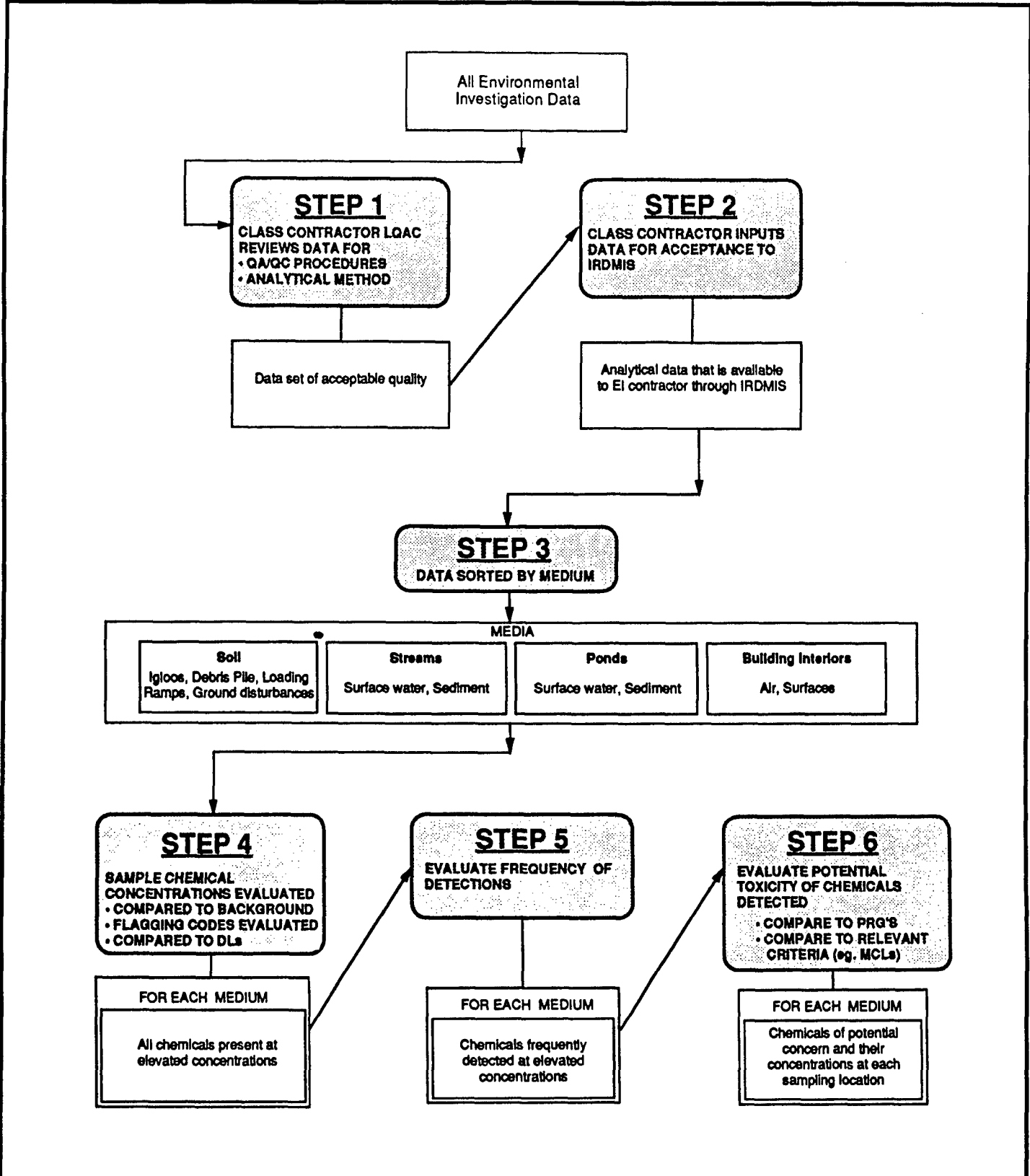
Potential carcinogenic risks due to exposure to contaminants in soil are limited to the exposure units listed on Table 6-21 if a potential future residential use of the property is assumed. At these locations, there is a single compound of concern in soil -- 2,4-DNT -- which is anticipated to cause cancer. At only one location, Exposure Unit B3, 2,6-DNT also contributes to carcinogenic risk. However, it is emphasized that these calculated risks are based on single samples taken from discreet areas in front of the igloos where any contaminants swept from the igloos may have been concentrated. It is highly unlikely that any single individual would contact these specific areas over a period of 30 years, which is what is assumed under the conditions of exposure described by the residential scenario. Furthermore, should residential development occur in these areas it seems likely that the igloos would have to be demolished and removed, thus redistributing and most likely diluting any contaminated soil near the entrance of the igloos.

Under the most likely conditions of future site use -- a commercial/industrial scenario in which the site is used for temporary storage -- only three igloos (Igloos 1702, 2101 and 2108) are associated with elevated (i.e., greater than 1×10^{-6}) carcinogenic risk. It is emphasized that, as noted above, these conclusions are based on single samples taken from discrete areas in front of igloos where any contaminants may be concentrated. It is unlikely that a single individual would contact these specific areas repeatedly over 1, 5 or 10 years, as was assumed.

Carcinogenic risks due to exposure to naturally-occurring radon are indicated on Table 6-20. When an exposure duration of 5 or 10 years is assumed, most carcinogenic risks are in the range 1×10^{-5} to 1×10^{-4} ; when an exposure duration of only 1 year is assumed, most risks are in the range of 1×10^{-5} to 1×10^{-6} and none exceed 1×10^{-4} . It is re-emphasized that the exposure scenario assumed more than likely overestimates potential exposures that may occur to a single individual over the 1-, 5- or 10-year exposures estimated. Furthermore, in the case of radon, it is highly likely that activities in and around the storage igloos would result in ventilation of the igloos by opening the doors for extended periods of time, thus decreasing concentrations of radon in the air.

Estimates of the uncertainties associated with these estimates of potential risk associated with contaminated media at the Coosa River Storage Annex have been highlighted throughout the previous discussions. Major uncertainties are summarized on Table 6-22.

Potential environmental risk would be restricted to those aquatic phytoplankton and aquatic invertebrates present in the streams and ponds which may be exposed to lead in surface water and sediments. While these organisms are undoubtedly at some degree of biological risk, the ecological risks associated with contaminated media at the site are negligible.



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 DATE 06-29-92
 JEG NO. 10G30400

FIGURE 6-1
IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN
COOSA RIVER STORAGE ANNEX EI

JE JACOBS ENGINEERING GROUP INC. No. G304R61

US Army Corps of Engineers
 Toxic and Hazardous
 Materials Agency
 Contract No. DAAA15-90-D-0013-0004

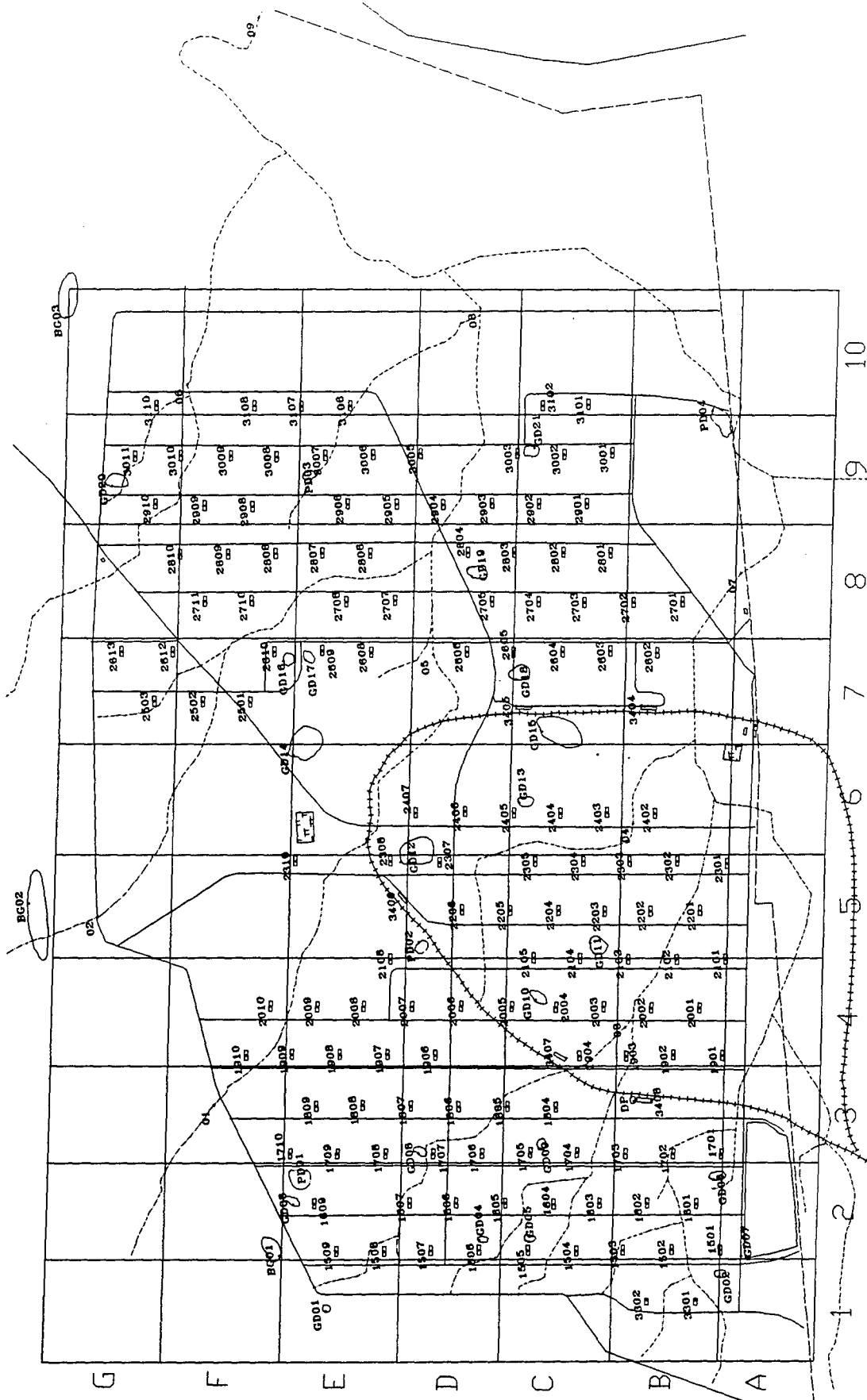


FIGURE 6-2

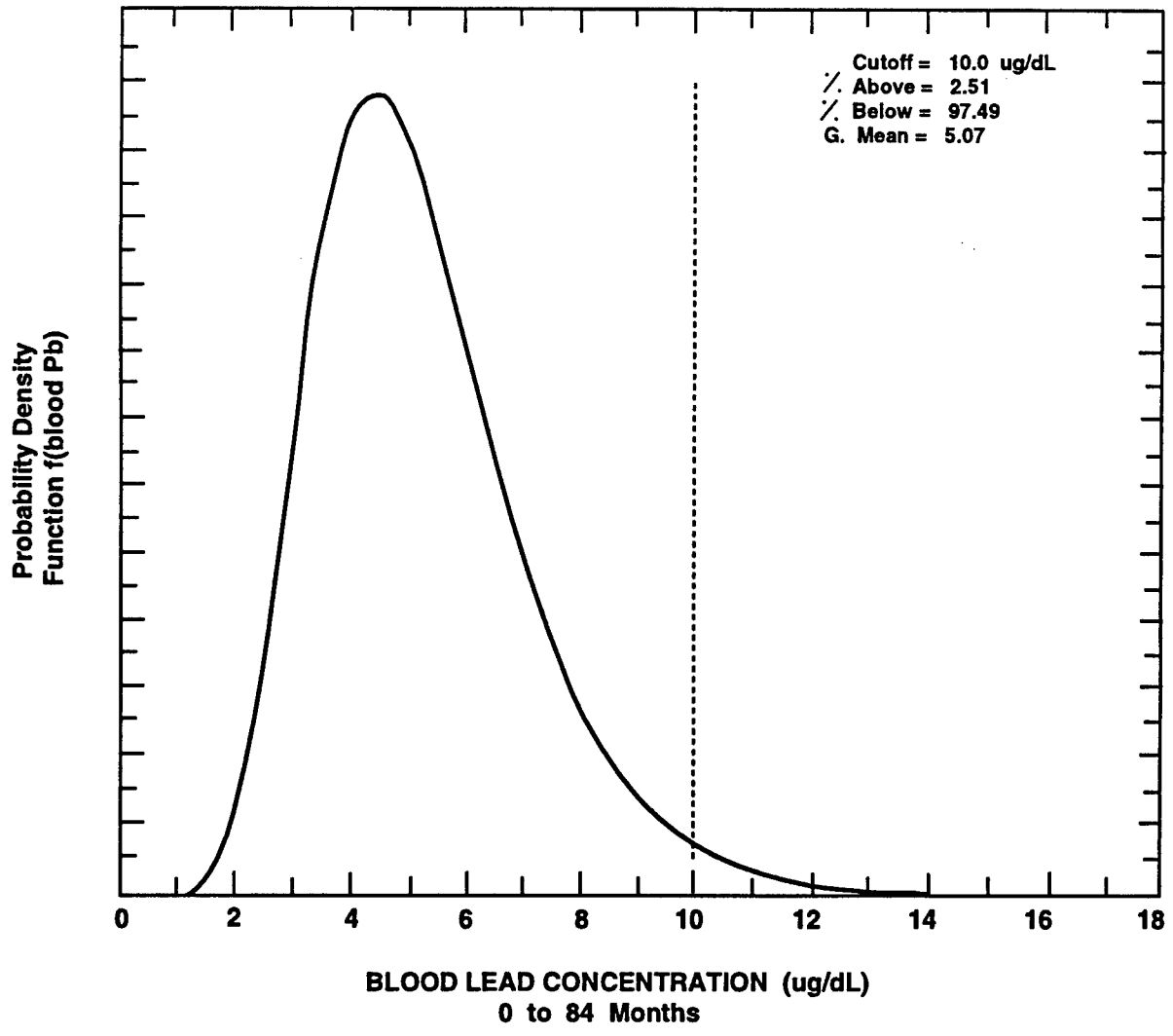
**EXPOSURE UNITS
COOSA RIVER STORAGE ANNEX EI**

**US Army Corps
of Engineers**
Toxic and Hazardous
Materials Agency
Contract No. DAAA15-90-D-0013-0004

DRAWN	KRL
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APRVED	MJS
DATE	06-29-92
JEG NO.	10G30400

JE JACOBS ENGINEERING GROUP INC.

No. G304R62



Probability function of blood lead concentration assuming exposure to 680 ug/g lead in soil using the Uptake/Biokinetic Model (Version 5.0)

Source: U.S. EPA Uptake/Biokinetic Model (Version 5.0)


DRAWN KRL		FIGURE 6-3		 US Army Corps of Engineers Toxic and Hazardous Materials Agency
CHKED		BLOOD LEAD CONCENTRATION PROBABILITY FUNCTION		
APRVED <i>MJS</i>		COOSA RIVER STORAGE ANNEX EI		
DATE 06-29-92		JE JACOBS ENGINEERING GROUP INC.		No. G304R63
JEG NO. 10G30400				Contract No. DAAA15-90-D-0013-0004

TABLE 6-1
 PRELIMINARY SOIL REMEDIATION GOALS
 COOSA RIVER ANNEX

<u>Analyte</u>	Risk-Based Concentrations (mg/kg)	
	<u>Carcinogens</u>	<u>Noncarcinogens</u>
Inorganics		
Lead (1)		8.23E+01
Mercury		
Explosives/Propellants		
1,3-Dinitrobenzene		2.74E+01
2,4-Dinitrotoluene	9.42E-01	
2,6-Dinitrotoluene	9.42E-01	
Nitrobenzene		1.37E+01
1,3,5-Trinitrobenzene		1.37E+01
2,4,6-Trinitrotoluene	2.13E+01	1.37E+02
Others		
Methylbenzene (toluene)		5.49E+04
Nitrocellulose (2)		

(1) PRG is not available because EPA has not derived toxicity values for lead; EPA requires the use of the Biokinetic/Uptake Model to estimate risk due to lead rather than the use of toxicity values.

(2) PRG is not available because EPA has not derived toxicity values; U.S. Army has found nitrocellulose to be "virtually nontoxic" (Ryon, 1986).

TABLE 6-2
 CHEMICALS DETECTED IN SOIL
 COOSA RIVER STORAGE ANNEX

Detected Compounds	Detection Limits (mg/kg)	Frequency of Detection (No. of hits/ No. of samples)	Detected Sample Range (mg/kg)	Background Range (mg/kg)	Chemical of Potential Concern? (yes)/(no)/Reason	Chemical of Potential Concern? (yes)/(no)/Reason
					Human Health	Environment
INORGANICS						
Lead	0.467	135/135	18 - 680	12 - 18	Yes/detected frequently above background	Yes/detected frequently above background
Mercury	0.050	57/135	0.058-0.624	ND	No/detected markedly below PRG	No/not ecotoxic at levels detected
EXPLOSIVES/PROPELLANTS						
2,4-dinitrotoluene	2.5	5/136	4.62 - 500	ND	Yes/classified as a probable carcinogen; detected above background and above PRG	No/infrequent detection in areas of low ecological significance
2,6-dinitrotoluene	2.0	1/136	32	ND	Yes/classified as a probable carcinogen; detected above background and above PRG	No/infrequent detection in areas of low ecological significance
Nitrocellulose	23.1	56/123	38.3 - 2500	ND - 155.0	No/not toxic ^a	No/not toxic ^a
DEBRIS PILE						
INORGANICS						
Lead	0.467	4/4	24 - 60	12 - 18	Yes/detected above background	Yes/detected above background
Mercury	0.050	2/4	0.065 - 0.069	ND	No/detected markedly below residential PRG	No/not ecotoxic at levels detected
EXPLOSIVES/PROPELLANTS						
Nitrocellulose	23.1	2/4	29.5, 39.7	ND - 155.0	No/not toxic ^a	No/not toxic ^a
OTHER						
Methyl benzene (toluene)	0.19	2/4	1.18, 1.24	ND	No/detected markedly below residential PRG	No/short environmental persistence

TABLE 6-2
 CHEMICALS DETECTED IN SOIL
 COOSA RIVER STORAGE ANNEX

Detected Compounds	Detection Limits (mg/kg)	Frequency of Detection (No. of hits/ No. of samples)	Detected Sample Range (mg/kg)	Background Range (mg/kg)	Chemical of Potential Concern? (yes)(no)/Reason	Chemical of Potential Concern? (yes)(no)/Reason
LOADING RAMPS						
INORGANICS						
Lead	0.467	5/5	32 - 520	12 - 18	Yes/detected frequently above background	Yes/detected frequently above background
Mercury	0.050	2/5	0.067 - 0.123	ND	No/detected markedly below residential PRG	No/not ecotoxic at levels detected
EXPLOSIVES/PROPELLANTS						
2,4-dinitrotoluene	2.5	1/5	5.62	ND	Yes/classified as a probable carcinogen; detected above background and PRG	No/single detection in area of low ecological significance
Nitrocellulose	23.1	3/5	27 - 258	ND - 155.0	No/not toxic ^a	No/not toxic ^a
GROUND DISTURBANCES						
INORGANICS						
Lead		21/21	6.09-26.0	12 - 18	No not detected much above background	No/not detected much above background
Mercury	0.050	6/21	0.062 - 0.074	ND	No/not detected above residential PRG	No/not ecotoxic at levels detected
EXPLOSIVES/PROPELLANTS						
Nitrocellulose	23.1	13/21	31.7 - 184.0	ND - 155.0	No/not toxic ^a	No/not toxic ^a

^a Ryon, Michael G. 1986. Water Quality Criteria for Nitrocellulose. Final Report. NTIS DE86012039; USEPA. 1987. Health Advisory for Nitrocellulose. NTIS PB90-273541.
 ND = Not detected
 NA = Not available
 PRG = Preliminary Remedial Goal

TABLE 6-3

CHEMICALS DETECTED IN STREAMS AND PONDS
COOSA RIVER STORAGE ANNEX

Detected Compounds	Detection Limits	Frequency of Detection (No. of hits/ No. of samples)	Detected Sample Range	Background Range	Chemical of Potential Concern? (yes)(no)/Reason	Chemical of Potential Concern? (yes)(no)/Reason
SEDIMENT - STREAMS	(mg/kg)		(mg/kg)	(mg/kg)	Human Health	Environment
Lead	0.467	10/10	4.74 - 33.0	22.0	No/not detected above background	Yes/potential source of water-borne lead
SEDIMENT - EXCAVATED PONDS			(mg/kg)	(mg/kg)		
Lead	0.467	4/4	16.0 - 22.0	22.0	No/not detected above background	Yes/potential source of water-borne lead
Nitrocellulose	23.1	3/4	55.5 - 74.2	150	No/not toxic ^a	No/not toxic ^a
SURFACE WATER - STREAMS	(µg/L)		(µg/L)	(µg/L)		
Lead	4.47	2/10	5.72, 6.3	ND	No/not detected markedly above background	Yes/available for bioconcentration
SURFACE WATER - PONDS						
Nitrocellulose		4/4	569-1510	431	No/not toxic ^a	No/not toxic ^a

^a Ryon, Michael G. 1986. Water Quality Criteria for Nitrocellulose. Final Report. NTIS DE86012039; USEPA. 1987. Health Advisory for Nitrocellulose. NTIS PB90-273541.

ND = Not Detected
NA = Not Available

TABLE 6-4

CHEMICALS DETECTED IN BUILDING INTERIORS
COOSA RIVER STORAGE ANNEX

Detected Compounds	Detection Limits	Frequency of Detection (No. of hits/ No. of samples)	Detected Sample Range	Background Range	Chemical of Potential Concern? (yes)(no)/Reason
AIR			(pCi/L)		
Alpha G (Radon)		14/14	1.0 - 12.7	NA	Yes/classified as a human carcinogen; detected above action level of 4pCi/L ^a
WIFE SAMPLES			(µg)		
TPHC		6/6	100.0 - 1000.0	NA	No/not toxic
Nitrobenzene	2.28	2/131	2.57 - 25.7	NA	Yes/exposure may result in adverse hematological effects
Nitrocellulose		133/133	14.0 - 196.0	NA	No/not toxic ^b
1,3,5-trinitrobenzene	1.84 - 15.6	1/131	1.84	NA	Yes/structurally similar to 2,4,6-trinitrotoluene which is classified as a possible carcinogen
2,4,6-trinitrotoluene	4.0	6/131	7.95 - 54.10	NA	Yes/classified as a possible carcinogen

NA = Not Available

^a US Army Action Level (Radon Protocol for Base Closure)

^b Ryon, Michael G. 1986. Water Quality Criteria for Nitrocellulose. Final Report. NTIS DE86012039; USEPA. 1987. Health Advisory for Nitrocellulose. NTIS PB90-273541.

TABLE 6-5

CHEMICALS OF POTENTIAL CONCERN
COOSA RIVER STORAGE ANNEX

MATRIX	LOCATION	ANALYTE	
		Human Health	Environment
Soil	Igloos	lead 2,4-dinitrotoluene 2,6-dinitrotoluene	lead
	Debris Pile	lead	lead
	Loading Ramps	lead 2,4-dinitrotoluene	lead
	Ground Disturbances	none identified	none identified
Sediment	Streams	none identified	lead
	Ponds	none identified	lead
Surface Water	Streams	none identified	lead
	Ponds	none identified	none identified
Building Interior	Air	radon	—
	Surfaces	nitrobenzene 1,3,5-trinitrobenzene 2,4,6-trinitrotoluene	—

TABLE 6-6

CHRONIC TOXICITY VALUES COOSA RIVER STORAGE ANNEX						
Analyte CAS Number	RfD (mg/kg-day) oral/dermal chronic; oral/dermal subchronic	Species	Critical Effect	Confidence Level	RfD Source/Basis	Uncertainty/ Modifying Factors ^a
ORAL/DERMAL EXPOSURE ROUTE						
lead 74396-92-1	not established - no level considered to be without effect					
2,4-dinitrotoluene 121-14-2	NA; NA					
2,6-dinitrotoluene 606-20-2	NA; NA					
nitrobenzene	0.0005/0.0005; 0.005/0.005	mouse; mouse	hematological, adrenal, renal, hepatic lesions; hematological, adrenal, renal, hepatic lesions	low; low	IRIS/air; HEAST/air	10000; 1000/1; 1
1,3,5-trinitrobenzene 99-35-4	0.00005/0.00005; 0.0005/0.0005	rat; rat	increased spleen weight; increased spleen weight	low; low	IRIS/water; HEAST/water	10000; 10000/1;1
2,4,6-trinitrotoluene 118-96-7	0.0005/0.0005; 0.0005/0.0005	dogs; dogs	liver toxicity; liver toxicity	medium; medium	IRIS/diet; HEAST/diet	1000; 1000/1; 1

a Uncertainty in RfD value results from variations in human sensitivity (10), extrapolation from observation in animal species (10), extrapolation from subchronic exposure to chronic exposures (10), extrapolation from a LOAEL to a NOAEL (10), or data deficiencies (1-10).

b For organic compounds dermal RfD is equivalent to oral RfD.

NA EPA has not performed quantitative risk assessment for noncarcinogenic effects (HEAST FY 1992).

HEAST Health Effects Assessment Summary Table (FY 1992).

TABLE 6-7

CARCINOGENIC TOXICITY VALUES COOSA RIVER STORAGE ANNEX					
Analyte CAS Number	Slope Factor mg/kg-day ⁻¹	Unit Risk μg/L ⁻¹	Weight of Evidence Classification	Type of Cancer	Unit Risk Basis/Source
Oral Exposure Route					
lead 7439-92-1	NA	NA	B2	multiple tumors in rats and mice	diet/IRIS
2,4-dinitrotoluene ^a 121-14-2	0.68	1.9 x 10 ⁻⁵	B2	liver and mammary gland tumors in rats	diet/IRIS
2,6-dinitrotoluene ^a 606-20-2	0.68	1.9 x 10 ⁻⁵	B2	liver and mammary gland tumors in rats	diet/IRIS
2,4,6-trinitrotoluene 118-96-7	0.030	9.0 x 10 ⁻⁷	C	urinary bladder cancer in rats	diet/IRIS
Inhalation Exposure Route (pCi) ⁻¹					
Radon 222 + progeny	7.7 x 10 ⁻¹²		A	lung cancer in humans	air/HEAST

- ^a 2,4- and 2,6-dinitrotoluene have not been evaluated separately for carcinogenicity. Values apply to a mixture of 2,4- and 2,6-dinitrotoluene isomers which has been classified as a probable human (B2) carcinogen.
- NA Not Available
 IRIS Integrated Risk Information System (3/92)
 HEAST Health Effects Assessment Summary Table (FY 1992)

TABLE 6-8
CHEMICAL INTAKE EQUATIONS

Ingestion of Chemicals in Soil, Residential Scenario:

$$\text{Intake (mg/kg-day)} = \frac{\text{CS} \times \text{IR} \times \text{CF}_1 \times \text{EF} \times \text{ED} \text{ (child)}}{\text{BW} \times \text{AT}} + \frac{\text{CS} \times \text{IR} \times \text{CF}_1 \times \text{EF} \times \text{ED} \text{ (adult)}}{\text{BW} \times \text{AT}}$$

Ingestion of Chemicals in Soil, Commercial/Industrial Scenario:

$$\text{Intake (mg/kg-day)} = \frac{\text{CS} \times \text{IR} \times \text{CF}_1 \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Dermal Contact with Chemicals in Soil:

$$\text{Intake (mg/kg-day)} = \frac{\text{CS} \times \text{CF}_1 \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED} \text{ (child)}}{\text{BW} \times \text{AT}} + \frac{\text{CS} \times \text{CF}_1 \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED} \text{ (adult)}}{\text{BW} \times \text{AT}}$$

Inhalation of Radon in Air:

$$\text{Intake (pCi/day)} = \text{CI} \times \text{InhR} \times \text{CF}_2 \times \text{EF} \times \text{ED}$$

Dermal Contact with Chemicals on Building Surfaces:

$$\text{Intake (mg/kg-day)} = \frac{\text{CBS} \times \text{ABS} \times \text{CF}_3 \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

ABS	=	absorption factor (unitless)
AF	=	soil to skin adherence factor (mg/cm ²)
AT	=	averaging time (days)
BW	=	body weight (kg)
CF ₁	=	conversion factor (10 ⁻⁶ kg/mg)
CF ₂	=	conversion factor (L/1 x 10 ⁻³ m ³)
CF ₃	=	conversion factor (10 ⁻³ mg/ug)
CI	=	radioactivity in air (pCi/L)
CBS	=	chemical amount contacted from building surfaces each day (ug/day)
CS	=	chemical concentration in soil (mg/kg)
ED	=	exposure duration (years)
EF	=	exposure frequency (days/year)
InhR	=	inhalation rate (m ³ /day)
IR	=	ingestion rate (mg/day)
SA	=	surface area available for contact (cm ²)

**TABLE 6-9
SOIL EXPOSURE POINT CONCENTRATIONS
COOSA RIVER STORAGE ANNEX**

Exposure Unit	Soil Sample Location				Concn in soil (ug/g)				Exposure Unit 95% UCL		
	Igloo	Debris Pile	Loading Ramp	Ground Disturbance	Lead DL=0.5	2,4-DNT DL=2.5	2,6-DNT DL=2.0	Lead	2,4-DNT	2,6-DNT	
A2				GD07(A)	22.0						
A3				GD07(B)	11.0						
B1	3301 3302			GD02	120.0 47.0 14.7	2.5 2.5	2.0 2.0	1244618.3	2.5	2.0	
B2	1501 1502 1503 1601 1602				310.0 390.0 120.0 270.0 88.0 9.8	2.5 2.5 2.5 2.5 2.5	2.0 2.0 2.0 2.0 2.0	12093.9	2.5	2.0	
B3	1701 1702 1703			GD06	64.0 90.0 160.0 24.0 60.0 31.0 29.0 32.0	2.5 500.0 2.5 2.5 2.5 2.5 2.5 2.5	2.0 32.0 2.0 2.0 2.0 2.0 2.0 2.0	128.1	1906.2	18.0	
B4	1901 1902 1903 2001 2002 2101 2102 2103		3408	DP01 DP02 DP03 DP04	280.0 77.0 66.0 120.0 130.0 160.0 89.0 60.0	2.5 2.5 2.5 2.5 2.5 33.0 2.5 2.5	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	199.5	17.0	2.0	
B5	2201 2202 2301 2302 2303				100.0 630.0 170.0 360.0 600.0	2.5 2.5 2.5 2.5 2.5	2.0 2.0 2.0 2.0 2.0	2107.8	2.5	2.0	
B6	2402				130.0	2.5	2.0				
B7	2602		3404		210.0 74.0	2.5 2.5	2.0 2.0	136483.3	2.5	2.0	
B8	2701				120.0	2.5	2.0				
C2	1504 1505 1603 1604 1605			GD05	33.0 81.0 27.0 260.0 68.0 26.0	2.5 2.5 2.5 2.5 2.5	2.0 2.0 2.0 2.0 2.0	495.8	2.5	2.0	

**TABLE 6-9
SOIL EXPOSURE POINT CONCENTRATIONS
COOSA RIVER STORAGE ANNEX**

Exposure Unit	Soil Sample Location				Concn in soil (ug/g)				Exposure Unit 95% UCL		
	Igloo	Debris Pile	Loading Ramp	Ground Disturbance	Lead DL=0.5	2,4-DNT DL=2.5	2,6-DNT DL=2.0	Lead	2,4-DNT	2,6-DNT	2,6-DNT
C3	1704				49.0	2.5	2.0	1850.2	11.4	2.0	
	1705				99.0	2.5	2.0				
	1804				51.0	2.5	2.0				
	1805				320.0	5.7	2.0				
C4				GD09	15.4						
	1904				91.0	2.5	2.0	305.9	2.5	2.0	
	2003				65.0	2.5	2.0				
	2004				90.0	2.5	2.0				
	2005				130.0	2.5	2.0				
	2104				28.0	2.5	2.0				
	2105				170.0	2.5	2.0				
C5			3407		58.0	2.5	2.0				
				GD10	9.6						
	2203				120.0	2.5	2.0	3668.6	4.1	2.0	
	2204				62.0	2.5	2.0				
	2205				180.0	2.5	2.0				
C6	2304				150.0	4.6	2.0				
	2305				200.0	2.5	2.0				
				GD11	9.5						
C7	2403				310.0	2.5	2.0	1.0E+10	2.5	2.0	
	2404				150.0	2.5	2.0				
	2405				280.0	2.5	2.0				
C8				GD13	12.1						
	2603				79.0	2.5	2.0	428.1	6.2	2.0	
	2604				130.0	2.5	2.0				
	2605				27.0	2.5	2.0				
			3405		100.0	5.6	2.0				
C9				GD15(B)	23.0						
				GD18	14.0						
C10	2703				250.0	2.5	2.0	566.5	2.5	2.0	
	2704				93.0	2.5	2.0				
	2801				60.0	2.5	2.0				
	2802				280.0	2.5	2.0				
	2803				130.0	2.5	2.0				
D2	2901				ND	2.5	2.0	262.9	2.5	2.0	
	2902				110.0	2.5	2.0				
	3001				22.5	2.5	2.0				
	3002				28.0	2.5	2.0				
D2	3003				56.0	2.5	2.0				
	3101				54.0	2.5	2.0	384.2	2.5	2.0	
	3102				30.0	2.5	2.0				
D2	1506				31.0	2.5	2.0	1355.4	2.5	2.0	
	1507				21.0	2.5	2.0				
	1606				180.0	2.5	2.0				
	1607				120.0	2.5	2.0				
				GD04	13.3						

**TABLE 6-9
SOIL EXPOSURE POINT CONCENTRATIONS
COOSA RIVER STORAGE ANNEX**

Exposure Unit	Soil Sample Location				Concn in soil (ug/g)				Exposure Unit 95% UCL		
	Igloo	Debris Pile	Loading Ramp	Ground Disturbance	Lead DL=0.5	2,4-DNT DL=2.5	2,6-DNT DL=2.0	Lead	2,4-DNT	2,6-DNT	
D3	1706				180.0	2.5	2.0	8028.0	2.5	2.0	
	1707				140.0	2.5	2.0				
	1806				240.0	2.5	2.0				
	1807				43.0	2.5	2.0				
D4				GD08	11.0						
	1906				200.0	2.5	2.0	1520.2	2.5	2.0	
	1907				100.0	2.5	2.0				
	2006				310.0	2.5	2.0				
	2007				270.0	2.5	2.0				
D5	2108				470.0	22.0	2.0	4452.0	67.3	2.0	
	2206				130.0	2.5	2.0				
	2307				200.0	2.5	2.0				
	2308		3406		95.0	2.5	2.0				
				GD12(A)	95.0	2.5	2.0				
					15.0						
D6	2406				93.0	2.5	2.0	2644950.6	2.5	2.0	
	2407				110.0	2.5	2.0				
D7	2606				15.0			2.8E+14			
				GD21	95.0	2.5	2.0				
D8	2705				300.0	2.5	2.0	5.1E+09	2.5	2.0	
	2707				39.0	2.5	2.0				
	2804				190.0	2.5	2.0				
				GD19	11.4						
D9	2903				47.0	2.5	2.0	126.5	2.5	2.0	
	2904				28.0	2.5	2.0				
	2905				33.0	2.5	2.0				
	3005				62.0	2.5	2.0				
	1508				71.0	2.5	2.0	3886.3	2.5	2.0	
E2	1509				33.0	2.5	2.0				
	1609				32.0	2.5	2.0				
E3				GD03	11.2						
	1708				60.0	2.5	2.0	161.7	2.5	2.0	
	1709				32.0	2.5	2.0				
	1710				50.0	2.5	2.0				
	1808				130.0	2.5	2.0				
E4	1809				86.0	2.5	2.0				
	1908				52.0	2.5	2.0	3403.8	2.5	2.0	
E5	1909				48.0	2.5	2.0				
	2008				400.0	2.5	2.0				
	2009				170.0	2.5	2.0				
	2310				18.0	2.5	2.0				
E6				9.8							
				GD14(A)							

**TABLE 6-9
SOIL EXPOSURE POINT CONCENTRATIONS
COOSA RIVER STORAGE ANNEX**

Exposure Unit	Soil Sample Location			Concn in soil (ug/g)				Exposure Unit 95% UCL		
	Igloo	Debris Pile	Loading Ramp	Ground Disturbance	Lead DL=0.5	2,4-DNT DL=2.5	2,6-DNT DL=2.0	Lead	2,4-DNT	2,6-DNT
E7	2608				54.0	2.5	2.0	171.7	2.5	2.0
	2609				33.0	2.5	2.0			
	2610				39.0	2.5	2.0			
E8				GD14(B) GD16	14.0	7.4		282.6	2.5	2.0
	2708				63.0	2.5	2.0			
	2806				170.0	2.5	2.0			
	2807				160.0	2.5	2.0			
	2808				110.0	2.5	2.0			
E9	2906				200.0	2.5	2.0	1268.5	2.5	2.0
	3006				41.0	2.5	2.0			
	3007				33.0	2.5	2.0			
	3008				21.0	2.5	2.0			
E10	3106				140.0	2.5	2.0	1.2E+09	2.5	2.0
	3107				680.0	2.5	2.0			
F4	1910				55.0	2.5	2.0	11743.6	2.5	2.0
	2010				130.0	2.5	2.0			
F7	2501				84.0	2.5	2.0	269.3	2.5	2.0
	2502				64.0	2.5	2.0			
	2612				39.0	2.5	2.0			
F8	2710				51.0	2.5	2.0	224.0	2.5	2.0
	2711				110.0	2.5	2.0			
	2809				90.0	2.5	2.0			
	2810				150.0	2.5	2.0			
F9	2908				37.0	2.5	2.0	83.6	2.5	2.0
	2909				53.0	2.5	2.0			
	3009				32.0	2.5	2.0			
	3010				23.0	2.5	2.0			
F10	3108				32.0	2.5	2.0			
G7	2503				130.0	2.5	2.0	590.5	2.5	2.0
	2613				200.0	2.5	2.0			
G9	2910				57.0	2.5	2.0	72112.5	2.5	2.0
	3011			GD20	49.0	2.5	2.0			
G10	3110				20.0	2.5	2.0			

2,4-DNT = 2,4-dinitrotoluene
 2,6-DNT = 2,6-dinitrotoluene
 DPxx = debris pile sample
 GDxx = ground disturbance sample
 DL = detection limit
 ND = Not determined
 ABQ/coos-cs2.xls

**TABLE 6-10
BUILDING INTERIOR EXPOSURE POINT CONCENTRATIONS
COOSA RIVER STORAGE ANNEX**

Idgno	Surfaces			Air (pCi/L) Radon
	NB	1,3,5-TNB	2,4,6-TNT	
1503	25.7		54.1	
1609			8.0	
1708			11.4	
1809			34.2	
1902	2.6			
1907			10.7	
3003		1.8	15.5	
2703				7.6
2905				8.8
2909				5.4
2910				5.7
3005				7.6
3006				8.9
3007				1.0
3008				5.6
3009				12.7
3010				5.8
3011				3.3
2906				1.8
2903				8.8
2902				3.5
2908				

NB = nitrobenzene
 1,3,5-TNB = 1,3,5-trinitrobenzene
 2,4,6-TNT = 2,4,6-trinitrotoluene

TABLE 6-11
EXPOSURE PARAMETERS
RESIDENTIAL SCENARIO
COOSA RIVER STORAGE ANNEX SITE

Ingestion of Chemicals in Soil

	<u>Child</u>	<u>Adult</u>
Age ¹	1 through 6 years	7 through 30 years
Ingestion Rate ¹ (mg/day)	200	100
Conversion Factor ₁ (kg/mg)	1×10^{-6}	1×10^{-6}
Exposure Frequency ¹ (days/yr)	350	350
Exposure Duration (yrs)	6	24
Body Weight ¹ (kg)	15	70
Averaging Time ¹ (days)		
Non-carcinogens	2190	8760
Carcinogens	25550	25550

Dermal Contact with Chemicals in Soil

	<u>Child</u>	<u>Adult</u>
Age ²	3 through 10 years	11 through 30 years
Surface Area Contacted ³ (cm ²)	2500	5000
Soil to Skin Adherence Factor ⁴ (mg/cm ²)	1.0	1.0
Absorption Factor ⁵	0.01 - 0.8	0.01 - 0.8
Exposure Frequency ⁶ (days/years)	250	100
Exposure Duration (years)	8	19
Body Weight ⁷	26	70
Averaging Time (days)		
Non-carcinogens	2920	6935
Carcinogens	25550	25550

¹U.S. EPA 1991c.

²Assuming children from the ages of 3 through 10 are most likely to spend a considerable period of time outdoors.

³Assuming 25% of total body surface area may be exposed to soil; default value (US EPA 1991c).

⁴Default value (US EPA 1991c).

⁵Dermal absorption for nitroaromatics assumed to be relatively high, 0.80 (USATHAMA 1991a,b,c; 1992); dermal absorption for tetryl assumed to be low, 0.01 (Zambrano and Mandovano, 1956, cited in USATHAMA 1991d); absorption for lead assumed to be 0.01 (ATSDR 1992).

⁶Assuming children are outdoors 5 days of every week they are at home throughout the year and that adults are outdoors two days every week (weekends) they are at home throughout the year.

⁷Average weight for children 3 - 12 years and average weight for adults (US EPA 1990, Exposure Factors Handbook).

**TABLE 6-12
REASONABLE MAXIMUM EXPOSURE
RESIDENTIAL SCENARIO
SOIL EXPOSURE
COOSA RIVER STORAGE ANNEX**

Exposure Unit	Exposure Point Concentration (ug/g)		Ingestion Intake (mg/kg-day)		Dermal Intake (mg/kg-day)	
	2,4 DNT	2,6 DNT	2,4 DNT	2,6 DNT	2,4 DNT	2,6 DNT
B4	33.0		5.2E-05		3.4E-04	
B3	500.0	32.0	7.8E-04	5.0E-05	5.1E-03	3.3E-04
C3	5.7		8.9E-06		5.9E-05	
C5	4.6		7.2E-06		4.7E-05	
C7	5.6		8.8E-06		5.8E-05	
D5	22.0		3.4E-05		2.3E-04	

2,4-DNT = 2,4-dinitrotoluene
2,6-DNT = 2,6-dinitrotoluene

**TABLE 6-13
EXPOSURE PARAMETERS
COMMERCIAL/INDUSTRIAL SCENARIO
COOSA RIVER STORAGE ANNEX SITE**

Ingestion of Chemicals in Soil

Ingestion Rate ¹ (mg/day)	50
Conversion Factor ₁ (kg/mg)	1 x 10 ⁻⁶
Exposure Frequency ² (days)	20
Exposure Duration ³ (yrs)	1, 5 or 10
Body Weight ⁴ (kg)	70
Averaging Time ⁴ (days)	
Non-carcinogens	365, 1825 or 3650
Carcinogens	25550

Dermal Contact with Chemicals in Soil

Surface Area ⁵ (cm ²)	820
Adherence Factor ⁶ (mg/cm ²)	1.0
Absorption Factor ⁷	0.01 - 0.80
Conversion Factor ₁ (mg/kg)	1 x 10 ⁻⁶
Exposure Frequency ² (days/year)	20
Exposure Duration ³ (years)	1, 5 or 10
Body Weight ⁴	70
Averaging Time ⁴ (days)	
Non-carcinogens	365, 1825 or 3650
Carcinogens	25550

Dermal Contact with Chemicals on Building Surfaces

Absorption Factor ⁷	0.01 - 0.80
Exposure Frequency ⁸ (days)	20
Exposure Duration ³ (years)	1, 5 or 10
Conversion Factor ₂ (mg/ug)	1 x 10 ⁻³
Body Weight ⁴ (kg)	70
Averaging Time ⁴ (days)	
Non-carcinogens	365, 1825 or 3650
Carcinogens	25550

TABLE 6-13 (continued)
EXPOSURE PARAMETERS
COMMERCIAL/INDUSTRIAL SCENARIO
COOSA RIVER STORAGE ANNEX SITE

Inhalation of Radon in Air

Inhalation Rate ⁴ (m ³ /day)	20
Exposure Frequency ⁸ (days/yr)	20
Exposure Duration ⁹ (years)	1, 5 or 10

¹Interim default for adult ingestion of soil and dust in the "typical" workplace (U.S. EPA 1991b).

²Assuming an individual works within the exposure unit 5 days/week for 4 weeks/year.

³Assuming an individual works within, and around, the same igloo for a total of 1, 5, or 10 years.

⁴U.S. EPA 1991b.

⁵Adult male 50th percentile surface area for hands (U.S. EPA 1990 Exposure Factors Handbook).

⁶Default value (U.S. EPA 1991c).

⁷Dermal absorption for nitroaromatics assumed to be relatively high, 0.80 (USATHAMA 1991a,b,c; 1992); dermal absorption for tetryl assumed to be low, 0.01 (Zambrano and Mandovano, 1956, cited in USATHAMA 1991d); absorption for lead assumed to be 0.01 (ATSDR, 1992).

⁸Assuming an individual may be likely to work within a single specific igloo for a period of four weeks (20 working days) in one year.

⁹Assuming an individual works four weeks out of the year within a specific igloo for a total of 1, 5 or 10 years.

**TABLE 6-14
REASONABLE MAXIMUM EXPOSURE
COMMERCIAL/INDUSTRIAL SCENARIO**

**SOIL EXPOSURE
COOSA RIVER ANNEX**

Years	Days/yr	Exposure Unit	Igloo/Loading Ramp	Chemical Conc'n in Soil (ug/g)		Ingestion Intake (mg/kg-day)		Dermal Intake (mg/kg-day)	
				2,4-DNT	2,6-DNT	2,4-DNT	2,6-DNT	2,4-DNT	2,6-DNT
10	20	B4	2101	33.0		1.8E-07		2.4E-06	
		B3	1702	500.0	32.0	2.8E-06	1.8E-07	3.7E-05	2.3E-06
		C3	1805	5.7		3.2E-08		4.2E-07	
		C5	2304	4.6		2.6E-08		3.4E-07	
		C7	3405	5.6		3.1E-08		4.1E-07	
		D5	2108	22		1.2E-07		1.6E-06	
5	20	B4	2101	33.0		9.2E-08		1.2E-06	
		B3	1702	500.0	32.0	1.4E-06	8.9E-08	1.8E-05	1.2E-06
		C3	1805	5.7		1.6E-08		2.1E-07	
		C5	2304	4.6		1.3E-08		1.7E-07	
		C7	3405	5.6		1.6E-08		2.1E-07	
		D5	2108	22		6.2E-08		8.1E-07	
1	20	B4	2101	33.0		1.8E-08		2.4E-07	
		B3	1702	500.0	32.0	2.8E-07	1.8E-08	3.7E-06	2.3E-07
		C3	1805	5.7		3.2E-09		4.2E-08	
		C5	2304	4.6		2.6E-09		3.4E-08	
		C7	3405	5.6		3.1E-09		4.1E-08	
		D5	2108	22		1.2E-08		1.6E-07	

2,4-DNT = 2,4-dinitrotoluene
2,6-DNT = 2,6-dinitrotoluene

abq/COOS-IN2.xls

**TABLE 6-15
REASONABLE MAXIMUM EXPOSURE
COMMERCIAL/INDUSTRIAL SCENARIO**

**BUILDING INTERIORS: SURFACES
COOSA RIVER STORAGE ANNEX**

Years	Days/yr	Igloo	NB	Dermal Intake (mg/kg-day)		Dermal Intake (mg/kg-day) Carcinogenic Effects 2,4,6-TNT*
				Non-carcinogenic Effects 1,3,5-TNB	2,4,6-TNT	
10	20	1503	1.6E-05			
		1609		3.4E-05	4.8E-06	
		1708		5.0E-06	7.1E-07	
		1710		7.1E-06	1.0E-06	
		1809		2.1E-05	3.1E-06	
		1902	1.6E-06			
		3003		6.7E-06	9.6E-07	
2703		9.7E-06	1.4E-06			
5	20	1503	1.6E-05			
		1609		3.4E-05	2.4E-06	
		1708		5.0E-06	3.6E-07	
		1710		7.1E-06	5.1E-07	
		1809		2.1E-05	1.5E-06	
		1902	1.6E-06			
		3003		6.7E-06	4.8E-07	
2703		9.7E-06	6.9E-07			
1	20	1503	1.6E-05			
		1609		3.4E-05	4.8E-07	
		1708		5.0E-06	7.1E-08	
		1710		7.1E-06	1.0E-07	
		1809		2.1E-05	3.1E-07	
		1902	1.6E-06			
		3003		6.7E-06	9.6E-08	
2703		9.7E-06	1.4E-07			

NB = nitrobenzene
1,3,5-TNB = 1,3,5-trinitrobenzene
2,4,6-TNT = 2,4,6-trinitrotoluene

*2,4,6-TNT is classified as a C (possible human) carcinogen. EPA does not require that carcinogenic risks for C carcinogens be quantified. Possible carcinogenic risks due to 2,4,6-TNT are evaluated here to provide an absolute upper range of carcinogenic risks associated with the Annex.

TABLE 6-16
REASONABLE MAXIMUM EXPOSURE
COMMERCIAL/INDUSTRIAL SCENARIO
BUILDING INTERIORS: AIR
COOSA RIVER STORAGE ANNEX

Years	Days/yr	Exposure Unit	Igloo	Air Intake (pCi)	
				Radon	Radon
10	20	D9	2905	3.04E+07	
		F9	2909	3.52E+07	
		G9	2910	2.16E+07	
		D9	3005	2.28E+07	
		E9	3006	3.04E+07	
		E9	3007	3.56E+07	
		E9	3008	4.00E+06	
		F9	3009	2.24E+07	
		F9	3010	5.08E+07	
		G9	3011	2.32E+07	
		E9	2906	1.32E+07	
		D9	2903	7.20E+06	
		C9	2902	3.52E+07	
		F9	2908	1.40E+07	
5	20	D9	2905	1.52E+07	
		F9	2909	1.76E+07	
		G9	2910	1.08E+07	
		D9	3005	1.14E+07	
		E9	3006	1.52E+07	
		E9	3007	1.78E+07	
		E9	3008	2.00E+06	
		F9	3009	1.12E+07	
		F9	3010	2.54E+07	
		G9	3011	1.16E+07	
		E9	2906	6.60E+06	
		D9	2903	3.60E+06	
		C9	2902	1.76E+07	
		F9	2908	7.00E+06	
1	20	D9	2905	3.04E+06	
		F9	2909	3.52E+06	
		G9	2910	2.16E+06	
		D9	3005	2.28E+06	
		E9	3006	3.04E+06	
		E9	3007	3.56E+06	
		E9	3008	4.00E+05	
		F9	3009	2.24E+06	
		F9	3010	5.08E+06	
		G9	3011	2.32E+06	
		E9	2906	1.32E+06	
		D9	2903	7.20E+05	
		C9	2902	3.52E+06	
		F9	2908	1.40E+06	

**TABLE 6-17
CHEMICAL-SPECIFIC CARCINOGENIC RISKS
RESIDENTIAL SCENARIO**

**SOIL EXPOSURE
COOSA RIVER STORAGE ANNEX**

<u>Exposure Unit</u>	<u>Igloo/ Loading Ramp</u>	<u>Ingestion</u>		<u>Dermal Contact</u>		<u>Total</u>	<u>>10⁻⁶</u>	<u>>10⁻⁵</u>	<u>>10⁻⁴</u>
		<u>2,4-DNT</u>	<u>2,6-DNT</u>	<u>2,4-DNT</u>	<u>2,6-DNT</u>				
B4	2101	3.5E-05	2.3E-04	2.7E-04	X	X	X	X	
B3	1702	5.3E-04	3.4E-05	4.3E-03	X	X	X	X	
C3	1805	6.1E-06	4.0E-05	4.6E-05	X	X	X	X	
C5	2304	4.9E-06	3.2E-05	3.7E-05	X	X	X	X	
C7	3405	6.0E-06	3.9E-05	4.5E-05	X	X	X	X	
D5	2108	2.3E-05	1.5E-04	1.8E-04	X	X	X	X	

2,4-DNT = 2,4-dinitrotoluene
2,6-DNT = 2,6-dinitrotoluene

**TABLE 6-18
NON-CARCINOGENIC RISK
COMMERCIAL/INDUSTRIAL SCENARIO
COOSA RIVER STORAGE ANNEX**

		Surfaces				
Years	Days/Yr	Igloo	NB	2,4,6-TNT	Interior	
		Hazard Quotient	Hazard Quotient	Hazard Quotient	Surface	HI >1.0
10	20	3.2E-02	3.2E-02	6.8E-02	Hazard Index	
		1503			3.2E-02	
		1609		6.8E-02	6.8E-02	
		1708		1.0E-02	1.0E-02	
		1710		1.4E-02	1.4E-02	
		1809		4.3E-02	4.3E-02	
		1902	3.2E-03		3.2E-03	
		1907		1.3E-02	1.3E-02	
		3003		1.9E-02	1.9E-02	
5	20	1503	3.2E-03		3.2E-03	
		1609		6.8E-02	6.8E-02	
		1708		1.0E-02	1.0E-02	
		1710		1.4E-02	1.4E-02	
		1809		4.3E-02	4.3E-02	
		1902	3.2E-04		3.2E-04	
		1907		1.3E-02	1.3E-02	
		3003		1.9E-02	1.9E-02	
1	20	1503	3.2E-03		3.2E-03	
		1609		6.8E-02	6.8E-02	
		1708		1.0E-02	1.0E-02	
		1710		1.4E-02	1.4E-02	
		1809		4.3E-02	4.3E-02	
		1902	3.2E-04		3.2E-04	
		1907		1.3E-02	1.3E-02	
		3003		1.9E-02	1.9E-02	

Chronic Reference Doses (RfD) were used in deriving the hazard quotients (HQ) for the 10-year duration of exposure; subchronic RfDs were used in deriving the HQs for the 5- and 1-year exposures.

TABLE 6-20
CHEMICAL-SPECIFIC CARCINOGENIC RISKS
COMMERCIAL/INDUSTRIAL SCENARIO
BUILDING INTERIORS: AIR
COOSA RIVER ANNEX

Years	Days/yr	Exposure		Radon Risk				
		Unit	Igloo	>10 ⁻⁶	>10 ⁻⁵	>10 ⁻⁴	>10 ⁻⁴	
10	20	D9	2905	2.3E-04	X	X	X	X
		F9	2909	2.7E-04	X	X	X	X
		G9	2910	1.7E-04	X	X	X	X
		D9	3005	1.8E-04	X	X	X	X
		E9	3006	2.3E-04	X	X	X	X
		E9	3007	2.7E-04	X	X	X	X
		E9	3008	3.1E-05	X	X	X	X
		F9	3009	1.7E-04	X	X	X	X
		F9	3010	3.9E-04	X	X	X	X
		G9	3011	1.8E-04	X	X	X	X
5	20	E9	2906	1.0E-04	X	X	X	X
		D9	2903	5.5E-05	X	X	X	X
		C9	2902	2.7E-04	X	X	X	X
		F9	2908	1.1E-04	X	X	X	X
		D9	2905	1.2E-04	X	X	X	X
		F9	2909	1.4E-04	X	X	X	X
		G9	2910	8.3E-05	X	X	X	X
		D9	3005	8.8E-05	X	X	X	X
		E9	3006	1.2E-04	X	X	X	X
		E9	3007	1.4E-04	X	X	X	X
1	20	E9	3008	1.5E-05	X	X	X	X
		F9	3009	8.6E-05	X	X	X	X
		F9	3010	2.0E-04	X	X	X	X
		G9	3011	8.9E-05	X	X	X	X
		E9	2906	5.1E-05	X	X	X	X
		D9	2903	2.8E-05	X	X	X	X
		C9	2902	1.4E-04	X	X	X	X
		F9	2908	5.4E-05	X	X	X	X
		D9	2905	2.3E-05	X	X	X	X
		F9	2909	2.7E-05	X	X	X	X
1	20	G9	2910	1.7E-05	X	X	X	X
		D9	3005	1.8E-05	X	X	X	X
		E9	3006	2.3E-05	X	X	X	X
		E9	3007	2.7E-05	X	X	X	X
		E9	3008	3.1E-06	X	X	X	X
		F9	3009	1.7E-05	X	X	X	X
		F9	3010	3.9E-05	X	X	X	X
		G9	3011	1.8E-05	X	X	X	X
		E9	2906	1.0E-05	X	X	X	X
		D9	2903	5.5E-06	X	X	X	X
1	20	C9	2902	2.7E-05	X	X	X	X
		F9	2908	1.1E-05	X	X	X	X

TABLE 6-21

LOCATIONS ASSOCIATED WITH ELEVATED CARCINOGENIC RISK (Risk > 1 x 10⁻⁶)
 DUE TO NITROAROMATICS
 COOSA RIVER STORAGE ANNEX

Exposure Unit	Igloos/Loading Ramp	Commercial/Industrial Scenario	Residential Scenario
		Soil	Soil
B3	1702	2,4-dinitrotoluene 2,6-dinitrotoluene	2,4-dinitrotoluene 2,6-dinitrotoluene
B4	2101	2,4-dinitrotoluene	2,4-dinitrotoluene
C3	1805		2,4-dinitrotoluene
C5	2304		2,4-dinitrotoluene
C7	3405		2,4-dinitrotoluene
D5	2108	2,4-dinitrotoluene	2,4-dinitrotoluene

TABLE 6-22

**MAJOR UNCERTAINTIES ASSOCIATED WITH ESTIMATES OF RISK
COOSA RIVER STORAGE ANNEX**

Potential Receptors	Medium Of Concern	Chemical of Concern	Potential Adverse Health Effect	Major Uncertainties	Effect on Risk Estimate
Future Workers	Soil	2,4-dinitrotoluene 2,6-dinitrotoluene	carcinogenicity carcinogenicity	potential exposure duration and contact rate	assumptions used likely to overestimate risk
				exposure point concentrations based on single detection/compounds detected at only 6 igloos	using highest detected level to estimate exposure may overestimate risk
Future Residents	Air	radon	carcinogenicity	2,4- and 2,6-DNT slope factor based on DNT mixture	may under or overestimate (more likely) carcinogenic risk
				2,6-DNT may be a more potent carcinogen than 2,4-DNT	may overestimate carcinogenic risk
		potential exposure duration and contact rate	assumptions used are likely to overestimate risk		
Future Residents	Soil	2,4-dinitrotoluene 2,6-dinitrotoluene	carcinogenicity carcinogenicity	exposure point concentration based on few detections/compounds detected at only five igloos and one loading ramp	using highest detected level or 95% UCL to estimate exposure may overestimate risk
				2,4- and 2,6-DNT slope factor based on DNT mixture	may under or over estimate (more likely) carcinogenic risk
				2,6-DNT may be a more potent carcinogen than 2,4-DNT	may overestimate carcinogenic risk

7.0 PRELIMINARY REMEDIAL ACTION OBJECTIVES AND ALTERNATIVES

According to the Baseline Risk Assessment conducted during this EI, the conditions at the Coosa River Storage Annex do not present an adverse environmental or ecological impact.

Based upon either current or reasonable future land usage, the analysis of baseline risk indicates that no noncarcinogenic hazards to human health exist at the Coosa River Storage Annex (i.e., hazard quotients and indices are less than 1.0), and that elevated (i.e., greater than 1×10^{-6}) carcinogenic risk exists based upon two exposure pathways:

- (1) Inhalation of naturally-occurring radon gas within the igloo interiors.

At an assumed 20 days/year exposure frequency and an exposure duration of 5 or 10 years, most risks due to radon exposure are in the range of 1×10^{-4} ; at an exposure duration of only 1 year, most risks are in the range of 1×10^{-5} and none are greater than 1×10^{-4} .

- (2) Contact with shallow subsurface soils at selected igloos and one loading ramp.

Under the most likely conditions of future site usage -- a commercial/industrial scenario similar to the current usage of the site -- only three igloos (Igloos 1702, 2101 and 2108) are associated with elevated (i.e., greater than 1×10^{-6}) carcinogenic risks due to site-activity attributable chemicals of potential concern; however, the risks are all less than 1×10^{-4} . These carcinogenic risks are within the 1×10^{-6} to 1×10^{-4} target risk range identified by the U.S. EPA [55 FR 8716].

If a potential future residential use of the property is assumed, potential risks due to exposure to site-activity attributable contaminants in soil are limited to Igloos 1702, 1805, 2102, 2108, 2304 and Loading Ramp 3405. Elevated (i.e., greater than 1×10^{-6}) carcinogenic risks exist at these locations. However, the potential carcinogenic risk exceeds 1×10^{-4} only at Igloos 1702, 2101 and 2108. Therefore, under this assumed albeit unlikely future use scenario, Igloos 1702, 2101 and 2108 present unacceptable carcinogenic risks (greater than 1×10^{-4}) due to soil exposure.

Moreover, residential development of the property would most likely require demolition of the igloos and loading ramps, and removal of the demolition

debris would likely result in partial removal of contaminated soils and dilution through soil redistribution during construction activities.

According to the U.S. EPA's OSWER Directive 9355.0-30, Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions [U.S. EPA, 1991d], "[w]here the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than $[1 \times] 10^{-4}$, and the non-carcinogenic [sic] hazard quotient is less than 1, [remedial] action is generally not warranted unless there are adverse environmental impacts."

Since conditions at the Annex meet these criteria, consistent with the NCP the Annex should be considered to be a no action site. Current U.S. EPA guidance further states that "in such situations, the FS [Feasibility Study] should either be scaled down as appropriate to that site and its potential hazard, or eliminated altogether" [U.S. EPA, 1988b]. Since the Annex is not on the National Priorities List (NPL), and is not under a Federal facilities agreement (FFA) with U.S. EPA, it is appropriate that no FS be performed.

The following subsections are presented with the intention of providing disclosure of these EI findings to potential property buyers/transferees.

7.1 DEVELOPMENT OF PRELIMINARY REMEDIAL ACTION OBJECTIVES

It is the responsibility of the current property owner/transferor to disclose to the potential buyer/transferee of the property the results of this EI, and to inform the transferee to assess the need to conduct remedial action consistent with the transferee's intended usage.

Potential preliminary remedial action objectives therefore focus on eliminating or limiting completed exposure pathways, either through institutional controls/administrative safeguards, or through remediating the contamination to levels which no longer present unacceptable risks, or through a combination of these two approaches, consistent with intended future site usage.

In accordance with the Department of the Army Technical Bulletin TB 700-4, Decontamination of Facilities and Equipment [Department of the Army, 1978], all contaminated items which are to be released to the general public are to be decontaminated to the XXXXX ("five Xs") degree before transfer. "Five Xs indicate the equipment or facilities have been completely decontaminated, and are free of hazard and may be released for general use or to the general public" [Department of the Army, 1978].

All contaminated items which are to be either transferred to a qualified government installation or activity, or furnished to a qualified user within industry, are to be decontaminated to a minimum of XXX ("three Xs") degree before transfer. Three Xs indicate that the equipment or facilities have been "decontaminated by approved procedures and no contamination can be detected ... and are considered safe for their intended use" [Department of the Army, 1978]. Items decontaminated to this degree can be furnished to industry or the general public if "administrative and technical safeguards will eliminate risk of injury."

The findings of the Baseline Risk Assessment (Section 6.0), as summarized above, indicate that the facilities at the Annex present no unacceptable carcinogenic risks or noncarcinogenic hazards due to site-activity attributable chemicals of concern for commercial/industrial usage.

If future site usage is commercial/industrial, similar to the current usage, the sole preliminary remedial action objective is to:

- (1) Assess the need to limit inhalation exposures to naturally-occurring radon gas in the buildings either through duration limitations or through reduction methods such as increased ventilation.

Carcinogenic risks slightly above the 1×10^{-4} upper bound of the U.S. EPA's target risk range exist at the both the 5- and 10-year exposure durations for inhalation of naturally-occurring radon. At the 1-year exposure duration, however, the carcinogenic risks are within the target risk range.

If the site is used in the future for residential purposes corresponding to the exposure assumptions of the residential use scenario, the sole preliminary remedial action objective is to:

- (2) Limit or eliminate contact with shallow subsurface soils which present potential carcinogenic risks which exceed 1×10^{-4} at Igloos 1702, 2101 and 2108.

7.2 PRELIMINARY REMEDIAL ALTERNATIVES

A preliminary remedial alternative has been formulated for each of the two identified media-specific preliminary remedial action objectives. Other viable alternatives are potential institutional controls, such as deed restrictions or administrative safeguards which restrict usage of certain locations and thereby eliminate exposure, or limit exposure duration or

exposure frequency, or standard operating procedures which do the same. If any physical remediation is to be undertaken, remedial alternatives should be evaluated in greater detail.

7.2.1 RADON

Radon concentrations within buildings may vary greatly over time [Gesell, 1983, Hess et al., 1985, Strunden et al., 1979, Fleischer and Turner, 1984, Wilkening and Wicke, 1986, Nyberg and Bernhardt, 1983 as cited in U.S. EPA, 1989c]. Furthermore, concentrations at different locations in the same building often vary by a factor of two or more [George et al., 1984, Hess et al., 1985, Keller et al., 1984 as cited in U.S. EPA, 1989c]. Because of these temporal and spatial variations, follow-up measurement is recommended when the initial screening measurement exceeds 4 pCi/L.

If the initial screening measurement exceeds 4 pCi/L and is less than 20 pCi/L, as is the case with the initial screening measurements conducted during this EI, the recommended follow-up measurement consists of 12-month integrated measurements made in several areas of the building. The 12-month measurement is achieved either through 4 successive 90-day measurements using gross alpha track radon detectors, as were used during the screening measurement conducted during this EI, or through the use of a long-term measurement device, such as a 12-month alpha-track detector. The average annual concentration in the building then can be used to estimate health risks and as a comparison to established guidance levels on the need for remedial action.

Considering that some of the buildings at the Annex are periodically utilized for training exercises during which ventilation is increased due to the door being open, the 12-month alpha detector would best integrate the actual radon gas concentration in the building interiors under real usage conditions. Placement of detectors at multiple locations in the buildings is also recommended during follow-up long term monitoring. Emphasis should be given to conducting the follow-up monitoring in buildings intended to be utilized by user populations under the usage scenario defined by the potential property transferee.

The average annual concentration in the individual buildings then can be used to reevaluate health risks and as a comparison to established guidance levels on the need for remedial action for those buildings intended for use. No decision on the need for permanent corrective action for radon should be made until completion of such a 12-month follow-up measurement period [U.S. EPA, 1987b].

7.2.2 SOIL

Literature research indicates that the nitroaromatics present in soil which are the source of the carcinogenic risks are susceptible to photolysis. Soil samples collected during this EI from the igloo areas were all collected after removing an overlying vegetation layer. The presence of the vegetative cover inhibits photolysis of these compounds by preventing their exposure to sunlight. Removal of the vegetative cover, and maintaining the areas around the igloos as denuded soil by periodic rototilling, would facilitate natural photolysis of these compounds. Methods other than rototilling should also be explored to break up soil lumps in order to maximize the surface area to volume ratio, and hence speed the photolysis to completion if remediation of soils is to be undertaken.

Little is known about the rate of photolysis of these nitroaromatic compounds. Prior to undertaking such an in-place photolytic remediation program, further literature or bench-scale research on reaction rates may be necessary in order to ascertain the duration of such a program. Alternatively, pilot-scale implementation of such an alternative technology program could be implemented, with proper routine sampling to generate empirical data on rates of reaction experienced in the field. Regardless of approach, limited further sampling during remediation (if any is to be undertaken) would be necessary to establish both the horizontal (areal) and vertical extent of soil contamination by these nitroaromatic compounds.

All igloo soil samples during this EI were collected immediately outside the igloo at the discharge point beneath the drainage channel grates affixed to the front wall of the igloo. Each sample submitted for analysis consisted of a composite of two aliquots, one from beneath each grate.

Since no general water service existed at the Annex other than at the bath house, it is unlikely that spillage of powdered materials on the igloo floors were hosed out of the igloos with any frequency. Migration of the contaminants likely occurred through either infrequent flushing of the floors and consequent drainage out the grates, or through sweeping of the floors either into the drainage channels and along the channels to the grates, or along the floors and out the igloo entrance and onto the pad, and then to the soils. The actual means of migration to the exterior soils could dramatically impact the horizontal extent of contamination. Collection of limited samples of soil at various locations in front of the identified igloos is recommended during remediation (if any is undertaken) to ascertain the areal extent of soil contamination.

Although literature research indicates the nitroaromatics found in the soils at the site have limited mobility in soil, collection of samples at several deeper depths is also recommended during remediation (if any is to be undertaken). All soil samples collected during the EI were from the 0-6 inch soil profile. Samples from the 12-18 inch, 18-24 inch, and 24-30 inch soil

regimes should be collected and analyzed in order to ascertain depth of the soil which needs to be remediated. Depth, and hence volume of contaminated media, along with reaction rates, will weigh heavily on determination of treatment duration.

Alternatively, if remediation of soils is to be undertaken, the soils could be excavated and run through an ultraviolet irradiation treatment train to achieve the desired photolytic reaction. This approach would also be very dependent on size reduction methodology in order to maximize the surface area to volume ratio of the soils fed through the treatment train. This treatment train approach, in contrast to natural photolysis, offers increased control of reaction rates through variation of the ultraviolet irradiation dose. Several irradiation methods are available, including arrays of ultraviolet light banks and solar collectors/concentrators.

8.0 SUMMARY AND CONCLUSIONS

8.1 SUMMARY

8.1.1 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination at the Coosa River Storage Annex were determined through source characterization and sampling of potentially affected media. Source characterization involved an analysis of components of the types of explosive materials handled at the Annex, a review of historical information for the Annex, and sampling of environmentally significant features at the Annex.

8.1.1.1 Source Characterization

Areas of environmental significance at the Annex that were investigated during the course of this EI include the 136 storage igloos, the five loading ramps (3404 through 3408), a single debris pile, 21 areas of ground disturbance, four "excavated" ponds, and 10 stream sampling stations. The following paragraphs discuss these features.

8.1.1.1.1 Igloos

Based on a review of the historical information for the Annex, from 1947 to 1982 the 136 storage igloos were used by ANAD to store containerized explosives, propellants (nonliquid), projectiles, and a variety of inert materials.

Given the use of these igloos, potential contaminants appear to be nitroaromatics and metals associated with the explosives and propellants which came from the Alabama Army Ammunition Plant and were stored at the Annex from 1941 to 1947. Following is a listing of typical components of these explosives:

- o Lead (associated with lead azide)
- o Mercury (associated with mercury fulminate)
- o 2,4-Dinitrotoluene (2,4-DNT)
- o 2,6-Dinitrotoluene (2,6-DNT)
- o 2,4,6-Trinitrotoluene (2,4,6-TNT)
- o Nitrocellulose (NC)
- o Tetryl

Given the construction of the igloos, there is also the potential for naturally-occurring radon gas to be present within those structures and other buildings on the Annex.

Because the igloo floors are cement, clean, dry and free of cracks, and because no liquids are reported to have been stored in the igloos at the Annex, any spillage would likely have been swept up and disposed. The soil outside the entranceway to the igloo is the probable point of release for any contamination swept out of an igloo. Other potential pathways for release would be through the drain trenches which are sloped to discharge through the grates to the surface soil at the front two corners of each igloo.

8.1.1.1.2 Loading Ramps

Five loading ramps are present at the Annex. There is the potential for spillage of nitroaromatics around the loading ramps during the materials handling conducted in these areas. Due to the volume of materials-handling activities conducted by rail during World War II, which is when the storage igloos of the Annex were most active, these loading ramp areas are the most probable locations of an accidental spill of explosives at the Annex.

The potential for both nitroaromatics and metals contamination appears to exist in the soils around the loading ramps as the result of activities previously conducted in the area.

8.1.1.1.3 Debris Pile

Located immediately north of Loading Ramp 3408 on road M-6 (identified as R5 in previous reports) is a pile of debris consisting of packing crates, wooden ammunition boxes, pallets, cylindrical mortar shell cases, and paper trash. This pile measures approximately 50 ft by 25 ft. Some of the mortar cases are reportedly covered with Cosmoline, which is a VaselineTM-like corrosion-inhibiting paste. Although the pile appears to have been present for several years, it is uncertain whether dumping occurred in this area during loading activities at the Annex. No evidence of such action is visible in this area in the aerial photographs presented in the EPIC report [EPIC, 1989]. It is believed that the wastes currently present have been placed in this area during the past several years.

Based on the types of wastes placed in the debris pile, potential contaminants include nitroaromatics, metals, and petroleum hydrocarbons.

8.1.1.1.4 Ground Disturbances

Twenty one areas of ground disturbance exist at the Annex that may have been used for waste disposal. The majority of the ground-disturbed areas appeared to be old borrow pits that either provided earthen cover for the igloos or provided fill to build roads. No evidence of waste disposal activities was observed at any of the locations. The majority of the ground disturbances are now partially or completely re-vegetated. Based on historical records, the ground disturbances do not appear to have been associated with burning or burial activities at the Annex; any explosives burning or waste disposal was reportedly conducted at ANAD. However, because little data are available about the disturbed areas at the Annex, the potential exists for these waste disposal activities to have occurred.

Because of the nature of materials handled at the Annex, nitroaromatics and metals are the two most probable types of potential contaminants.

8.1.1.1.5 Excavated Ponds

Four ponds have been identified at the Annex. The purpose of the ponds is not known, though they may be related to development of the property to accommodate cattle grazing leases granted at the Annex or perhaps used for surface water runoff control. Pond 4, located in the southeast corner of the present Annex property boundary, was observed during the field investigation of this EI to be a low-lying area where water accumulates due to the presence of a beaver dam. No evidence of excavation was observed in the area of Pond 4. Evidence of excavation was obvious at the other three ponds. Based on a review of historical records, the excavated ponds do not appear to have been associated with burning or burial activities at the Annex; any explosives burning or waste disposal was reportedly conducted at ANAD. However, because little data are available about these excavated pond areas at the Annex, the potential exists for these waste disposal activities to have occurred.

Because of the nature of materials handled at the Annex, nitroaromatics and metals are the two most probable types of potential contaminants.

8.1.1.1.6 Streams

The numerous streams that flow near many of the igloos are sites where potential contamination from activities conducted at the Annex may exist. Although no documented spills or waste disposal occurred in the streams, the potential exists for wastes to have entered into them through runoff.

Based on the type of materials handled at the Annex, contaminants potentially present in the streams include nitroaromatics and metals.

8.1.1.2 Environmental Media Sampling and Analysis

Sampling activities conducted during this EI are summarized below:

- o Collection and analysis of soil, surface water/sediment, wipe, and radon samples from areas previously identified to be potential contamination sources; and
- o Collection and analysis of soil and surface water/sediment samples to define background levels of potential contaminants of concern.

Site-activity attributable chemicals of potential concern detected on igloo interior surfaces at the Coosa River Storage Annex are the nitroaromatics nitrobenzene, 1,3,5-TNB, and 2,4,6-TNT. Concentrations of naturally occurring radon in igloo interiors are also of concern. Concentration ranges and detection frequencies for all chemicals detected on or in igloo interiors are presented on Table 6-4; concentrations of chemicals of concern used to determine risks at individual locations are presented on Table 6-10.

Site-activity attributable chemicals of potential concern detected in soils at the Annex are lead and the nitroaromatics 2,4-DNT and 2,6-DNT. Concentration ranges and detection frequencies for all chemicals detected in soil are presented on Table 6-2; concentrations of chemicals of concern used to determine risks at individual locations are presented on Table 6-9.

The only chemical of potential concern detected in surface water or sediments at the Annex is lead. Although lead was detected in stream surface water and sediment samples, and in pond sediment samples, it was not at levels above background ranges. None of the nitroaromatics detected on igloo interior surfaces or soils at the Annex have been detected during this EI in any surface water or sediment samples, neither in streams nor in ponds, indicating that once released to the exterior soil, migration to the other media examined during this EI has not occurred.

8.1.2 FATE AND TRANSPORT OF CONTAMINATION

Site-activity attributable chemicals of potential concern in soils at the Annex are lead and the nitroaromatics 2,4-DNT and 2,6-DNT.

When lead is released into the environment, it has a long residence time compared to most other pollutants. As a result, lead and its compounds tend to accumulate in soils and sediments, where, due to their low solubility and relative freedom from microbial degradation, they will remain accessible to the food chain and to humans far into the future. This means that the potential for exposure to lead via contact with contaminated surface soil currently exists at the Coosa River Storage Annex and will continue to exist unless contaminated soil is removed.

The nitroaromatics 2,4-DNT and 2,6-DNT exhibit moderate mobility in soil. They may therefore remain in surface soil where they may be contacted directly while also leaching to groundwater. These compounds are not expected to bioconcentrate in animal or plant life but may sorb (via adsorption or absorption) to sediment. Potential exposures may occur through ingestion of contaminated drinking water and from dermal and inhalation exposure of contaminated soil.

Site-activity attributable chemicals of potential concern detected on igloo interior surfaces at the Annex are the nitroaromatics nitrobenzene, 1,3,5-TNB, and 2,4,6-TNT.

The nitroaromatic compounds detected on building interior surfaces were most likely present as dusts on the concrete surfaces, since they normally exist and were stored as solids. Potential exposures are most likely to be via dermal contact. Although during routine activities in the igloos, particulates may become airborne and available for inhalation, this would represent a very minor pathway of exposure.

The results of the EI indicate that igloo interior surfaces at a limited number of igloos, and soils at limited locations, show detectable levels of site-activity attributable potential chemicals of concern. The results of the EI indicate that although the chemicals of potential concern have been released to the environment, they are not migrating from the soil media to the other environmental media examined.

Concentrations of naturally occurring radon in igloo interiors are also of potential concern. Radon is thought to occur naturally in most soils at an estimated 1 g radium per square mile of soil (at a depth of six inches). This, in turn, is released in tiny amounts to the environment. Radon exhalation from walls, floors, and ceilings is dependent on several factors including the radium concentration, and the quality and thickness of any applied sealant on wall, ceiling, and floor surfaces. Radon is further influenced by the ventilation rate of an enclosed space. The ventilation rate is influenced by many activities such as wind, barometric pressure, temperature, the opening of doors and windows, etc. On the average, radon is present in the greatest amounts in the summer, and at smaller amounts in the winter and spring.

Furthermore, radon levels are generally at their maximum in the early morning and their minimum at noon or in the afternoon. Consequently, potential exposures to radon would be via inhalation.

8.1.3 BASELINE RISK ASSESSMENT

A baseline risk assessment was performed to evaluate the potential threat to human health and the environment assuming no remedial action at the Coosa River Storage Annex.

The risk assessment was performed in two steps:

- (1) toxicity assessment, consisting of (a) a hazard evaluation and (b) a dose-response evaluation; and
- (2) exposure assessment, in which (a) the exposure setting was characterized in terms of the general physical characteristics of the Annex and the characteristics of the populations on or near the Annex that may contact contaminated media, (b) possible current and future exposure pathways were identified and evaluated, and (c) exposure point concentrations were derived for each chemical of potential concern in each medium of concern, chemical intakes for receptors in selected exposure pathways were calculated, and risks were evaluated.

Only complete pathways involving current or future contact with contaminated media were evaluated in the human health risk assessment. Thus, exposure pathways in which (1) the potentially exposed population is likely to contact a contaminated medium, or (2) the environmental medium contacted is significantly contaminated, have been selected for evaluation.

Soil and building (igloo) interior air and surfaces are the media contaminated at the Coosa River Storage Annex. Thus, exposure pathways that would result in the greatest potential exposures to these media have been selected for evaluation.

A potential residential scenario was selected for evaluation as a complete exposure pathway since future residential development of the Coosa River Storage Annex has not been ruled out. Evaluation of residential pathways should result in the reasonable maximum estimated exposures to the chemicals of potential concern in soil and hence the maximum possible estimated risk associated with this medium.

In order to provide an upper range of possible exposures for this risk assessment, it was assumed that, in the future, the Coosa River Storage Annex may be subdivided into 1,000 ft x 1,000 ft square residential plots (exposure units) approximately 23 acres in size (1,000,000 ft²) and that individuals would integrate exposure to contaminants in soil over this area. This size area was chosen because an area this size centered over the most highly contaminated soil would include all of the highest concentrations of the chemicals of potential concern identified in soil at the site. The division of the Coosa River Storage Annex into exposure units is shown on Figure 6-2.

Under the conditions of a residential exposure scenario, it is assumed that the buildings currently onsite would have been removed and replaced with private dwellings so that no exposures to contaminated air and surfaces in the building interiors is anticipated. It should be noted that during the demolition process and subsequent residential construction, contaminated soil, which is located primarily in close proximity to the front of the igloos, would most likely be redistributed and probably substantially diluted. Residential exposures based on the soil concentrations currently existing at the site are therefore highly likely to be overestimations.

Estimated exposures are based on the assumptions that a single individual will reside in a dwelling located within one of the exposure units from the age of 1 through the age of 30, and for the first 6 years will ingest 200 mg soil/day and for the remaining 24 years will ingest 100 mg soil/day. This is in accordance with the current SDEF guidance [U.S. EPA, 1991b]. Further, it is assumed that chronic dermal contact of soil will occur throughout that period. For both ingestion and dermal intake calculations, it is assumed that all soil contacted comes from a contaminated source. Quantification of exposure based on these assumptions is highly unlikely to underestimate exposures and is very highly likely to overestimate exposures. Potential inhalation intakes are anticipated to be insignificant compared to ingestion and dermal intakes under the conditions of the residential scenario and so are not estimated.

If the igloos remain standing, the most likely potentially exposed population are individuals (private or military) who may visit the site occasionally while engaged in storing and removing material from the storage igloos. Accordingly, potential exposures to soil, interior surfaces, and interior air of igloos have been quantified under such a commercial/industrial use scenario. This use scenario corresponds to the current use of the Annex.

Chemicals of potential concern in building interiors are naturally-occurring radon (air) and a variety of site-activity attributable nitroaromatic compounds (surfaces). Potential exposures to radon would be via inhalation. The nitroaromatic compounds detected on interior surfaces were most likely present as dusts on the concrete surfaces, since they normally exist and were stored as solids. Potential exposures are most likely to be via dermal contact.

Areas of elevated human health carcinogenic risk at the Coosa River Storage Annex were found to exist within only six exposure units -- B3, B4, C3, C5, C7 and D5. Within these exposure units, anticipated risks should be viewed as being limited to exposures to soil in areas in front of the specific igloos identified on Table 6-21. Elevated risks were not found to result from exposure to contaminants on building surfaces.

Since elevated risks occur only within six exposure units -- B3, B4, C3, C5, C7 and D5 -- and anticipated risks within those exposure units are limited to areas within and in front of specific igloos, concern should be focused on the specific igloos within each exposure unit as described below.

8.1.3.1 Assumed Future Residential Use

If a potential future residential use of the property is assumed, potential elevated (i.e., greater than 1×10^{-6}) carcinogenic risks due to exposure to contaminants in soil are limited to Igloos 1702 (Exposure Unit B3), 1805 (Exposure Unit C3), 2101 (Exposure Unit B4), 2108 (Exposure Unit D5), 2304 (Exposure Unit C5), and Loading Ramp 3405 (Exposure Unit C7). At these locations, there is a single compound of concern in soil -- 2,4-DNT -- which is anticipated to cause cancer. At only one location, Igloo 1702 (Exposure Unit B3), 2,6-DNT also contributes to carcinogenic risk. Risks associated with exposure to these compounds via ingestion and dermal contact with soil under the conditions of a residential scenario are indicated on Table 6-17. The estimated risks range from 3.2×10^{-5} at Igloo 2304 (Exposure Unit C5) to 4.3×10^{-3} at Igloo 1702 (Exposure Unit B3). However, the potential carcinogenic risk exceeds 1×10^{-4} only at Igloos 1702, 2101 and 2108. No potential noncarcinogenic human health hazards due to soil exposure are likely to exist.

The only chemical of potential concern in surface soil for which noncarcinogenic effects may be of concern is lead. According to the U.S. EPA's Uptake/Biokinetic (U/BK) Model (Version 5.0), the blood lead levels estimated to occur in children as a result of exposure to lead contaminated soil in a residential setting at the Coosa River Storage Annex is 5.07 ug/dL. As indicated on Figure 6-3, in the absence of exposure to any other lead contaminated media (e.g., water, air), 2.51% of the children exposed to the highest detected level of lead are expected to have blood lead levels exceeding 10 ug/dL, which is within the acceptable range of 5% or less. Therefore, exposure of children to lead-contaminated soil under the conditions of exposure of the very conservative residential scenario described at the Coosa River Storage Annex does not represent an unacceptable health risk.

No noncarcinogenic human health hazards were found to exist at the Coosa River Storage Annex.

8.1.3.2 Current and Assumed Future Commercial/Industrial Use

Under the most likely conditions of future site usage -- a commercial/industrial scenario in which the site is used for temporary storage, similar to the current usage of the site -- only three igloos are associated with elevated (i.e., greater than 1×10^{-6}) carcinogenic risk due to site-activity attributable chemicals of potential concern, Igloos 1702 (Exposure Unit B3), 2101 (Exposure Unit B4) and 2108 (Exposure Unit D5). Risks associated with exposure to these compounds via soil and building surfaces exposure pathways under the conditions of a commercial/industrial scenario are indicated on Table 6-19. Note that the potential carcinogenic risks never exceed 1×10^{-4} , regardless of exposure duration, and only exceed 1×10^{-6} at an exposure duration longer than 5 years. These carcinogenic risks are within the 1×10^{-6} to 1×10^{-4} target risk range identified by the U.S. EPA [55 FR 8716].

No noncarcinogenic human health hazards were found to exist at the Coosa River Storage Annex.

Under the commercial/industrial use scenario, at an assumed 20 days/year exposure frequency and an exposure duration of either 5 or 10 years, most risks due to exposure to naturally-occurring radon are in the range of 1×10^{-4} ; when an exposure duration of only 1 year is assumed, most risks are in the range of 1×10^{-5} and none exceed 1×10^{-4} . It is re-emphasized that the exposure scenario assumed more than likely overestimates potential exposures that may occur to a single individual over the 1-, 5- or 10-year exposures estimated. Moreover, in the case of radon, it seems highly likely that activities in and around the storage igloos would result in ventilation of the igloos by opening the doors for extended periods of time, thus decreasing concentrations in the air and decreasing actual risks.

8.2 CONCLUSIONS

8.2.1 DATA LIMITATIONS

The investigatory approach utilized in this EI targeted only those media and locations most likely to have been impacted during the operational life of the Coosa River Storage Annex. Samples were collected at locations where any contaminants present were likely to be concentrated.

Where multiple samples (e.g., multiple investigative samples over subareas or field replicates) were collected from a single site feature, the highest concentration detected was used to estimate the exposure point concentrations as presented on the tables in Section 6.0. Concentrations of analytes presented on Figures 4-1 through 4-3 use the same approach as noted for the tables in Section 6.0.

Conclusions regarding risks due to inhalation of naturally-occurring radon are based upon a single time-composited sample collected over a period with little ventilation since the igloo was sealed, and hence would not represent conditions under active usage.

Conclusions regarding soil exposure risks are based on single samples taken from discrete areas in front of igloos where any contaminants may be concentrated. Conclusions regarding building interior surface exposure risks are likewise based upon a single composite sample of surface contaminants within each igloo taken from discrete areas within each igloo where any contaminants may be concentrated.

8.2.3 RISK CONCLUSIONS

According to the Baseline Risk Assessment conducted during this EI, the conditions at the Coosa River Storage Annex do not present an adverse environmental or ecological impact.

Based upon either current or reasonable future land usage, the analysis of baseline risk indicates that no noncarcinogenic hazards to human health exist at the Coosa River Storage Annex (i.e., hazard quotients and indices are less than 1.0), and that elevated (i.e., greater than 1×10^{-6}) carcinogenic risk exists based upon two exposure pathways:

- (1) Inhalation of naturally-occurring radon gas within the igloo interiors.

At an assumed 20 days/year exposure frequency and an exposure duration of 5 or 10 years, most risks due to radon exposure are in the range of 1×10^{-4} ; at an exposure duration of only 1 year, most risks are in the range of 1×10^{-5} and none are greater than 1×10^{-4} .

- (2) Contact with shallow subsurface soils at selected igloos and one loading ramp.

Under the most likely conditions of future site usage -- a commercial/industrial scenario similar to the current usage of the site -- only three igloos (Igloos 1702, 2101 and 2108) are associated with elevated (i.e.,

greater than 1×10^{-6}) carcinogenic risks due to site-activity attributable chemicals of potential concern; however, the risks are all less than 1×10^{-4} . These carcinogenic risks are within the 1×10^{-6} to 1×10^{-4} target risk range identified by the U.S. EPA [55 FR 8716].

If a potential future residential use of the property is assumed, potential risks due to exposure to site-activity attributable contaminants in soil are limited to Igloos 1702, 1805, 2102, 2108, 2304 and Loading Ramp 3405. Elevated (i.e., greater than 1×10^{-6}) carcinogenic risks exist at these locations. However, the potential carcinogenic risk exceeds 1×10^{-4} only at Igloos 1702, 2101 and 2108. Therefore, under this assumed albeit unlikely future use scenario, Igloos 1702, 2101 and 2108 present unacceptable carcinogenic risks (greater than 1×10^{-4}) due to soil exposure.

Moreover, residential development of the property would most likely require demolition of the igloos and loading ramps, and removal of the demolition debris would likely result in partial removal of contaminated soils and dilution through soil redistribution during construction activities.

It is emphasized that these calculated risks should be viewed as indicating an absolute upper limit of potential risk associated with this site.

8.2.3 PRELIMINARY REMEDIAL ACTION OBJECTIVES

According to current U.S. EPA's guidance, "[w]here the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than $[1 \times 10^{-4}]$, and the non-carcinogenic [sic] hazard quotient is less than 1, [remedial] action is generally not warranted unless there are adverse environmental impacts" [U.S. EPA, 1991d].

Since conditions at the Annex meet these criteria, consistent with the NCP [40 CFR Part 300] the Annex should be considered to be a no action site. Current U.S. EPA guidance further states that "in such situations, the FS [Feasibility Study] should either be scaled down as appropriate to that site and its potential hazard, or eliminated altogether" [U.S. EPA, 1988b]. Since the Annex is not on the National Priorities List (NPL), and is not under a Federal facilities agreement (FFA) with U.S. EPA or ADEM, it is appropriate that no FS be performed.

The following paragraphs and subsections are presented with the intention of providing disclosure of these EI findings to potential property buyers/transferees.

It is the responsibility of the current property owner/transferor to disclose to the potential buyer/transferee of the property the results of this EI, and to inform the transferee to assess the need to conduct remedial action consistent with the transferee's intended usage.

Potential preliminary remedial action objectives therefore focus on eliminating or limiting completed exposure pathways, either through institutional controls/administrative safeguards, or through remediating the contamination to levels which no longer present unacceptable risks, or through a combination of these two approaches, consistent with intended future site usage.

In accordance with the Department of the Army Technical Bulletin TB 700-4, Decontamination of Facilities and Equipment [Department of the Army, 1978], all contaminated items which are to be released to the general public are to be decontaminated to the XXXXX ("five Xs") degree before transfer. "Five Xs indicate the equipment or facilities have been completely decontaminated, and are free of hazard and may be released for general use or to the general public" [Department of the Army, 1978].

All contaminated items which are to be either transferred to a qualified government installation or activity, or furnished to a qualified user within industry, are to be decontaminated to a minimum of XXX ("three Xs") degree before transfer. Three Xs indicate that the equipment or facilities have been "decontaminated by approved procedures and no contamination can be detected ... and are considered safe for their intended use" [Department of the Army, 1978]. Items decontaminated to this degree can be furnished to industry or the general public if "administrative and technical safeguards will eliminate risk of injury."

The findings of the Baseline Risk Assessment indicate that the facilities at the Annex present no unacceptable carcinogenic risks or noncarcinogenic hazards due to site-activity attributable chemicals of concern for commercial/industrial usage.

If future site usage is commercial/industrial, similar to the current usage, the sole preliminary remedial action objective is to:

- (1) Assess the need to limit inhalation exposures to naturally-occurring radon gas in the buildings either through duration limitations or through reduction methods such as increased ventilation.

Carcinogenic risks slightly above the 1×10^{-4} upper bound of the U.S. EPA's target risk range exist at the both the 5- and 10-year exposure durations for

inhalation of naturally-occurring radon. At the 1-year exposure duration, however, the carcinogenic risks are within the target risk range.

If the site is used in the future for residential purposes corresponding to the exposure assumptions of the residential use scenario, the sole preliminary remedial action objective is to:

- (2) Limit or eliminate contact with shallow subsurface soils which present potential carcinogenic risks which exceed 1×10^{-4} at Igloos 1702, 2101 and 2108.

Preliminary remedial action objectives therefore focus on eliminating or limiting completed exposure pathways, either through institutional controls/administrative safeguards, or through remediating the contamination to levels which no longer present unacceptable risks, or through a combination of these two approaches. It is the responsibility of the current property owner/transferor to disclose to the potential buyer/transferee of the property the results of this EI, and to inform the transferee to assess the need to conduct remedial action consistent with their intended usage.

8.2.4 PRELIMINARY REMEDIAL ALTERNATIVES

A preliminary remedial alternative has been formulated for each of the two identified media-specific preliminary remedial action objectives. Other viable alternatives are potential institutional controls, such as deed restrictions or administrative safeguards which restrict usage of certain locations and thereby eliminate exposure, or limit exposure duration or exposure frequency, or standard operating procedures which do the same. If any physical remediation is to be undertaken, remedial alternatives should be evaluated in greater detail.

8.2.4.1 Radon

Radon concentrations within buildings may vary greatly over time [Gesell, 1983, Hess et al., 1985, Strunden et al., 1979, Fleischer and Turner, 1984, Wilkening and Wicke, 1986, Nyberg and Bernhardt, 1983 as cited in U.S. EPA, 1989c]. Furthermore, concentrations at different locations in the same building often vary by a factor of two or more [George et al., 1984, Hess et al., 1985, Keller et al., 1984 as cited in U.S. EPA, 1989c]. Because of these temporal and spatial variations, follow-up measurement is recommended when the initial screening measurement exceeds 4 pCi/L.

If the initial screening measurement exceeds 4 pCi/L and is less than 20 pCi/L, as is the case with the initial screening measurements conducted during this EI, the recommended follow-up measurement consists of 12-month integrated measurements made in several areas of the building. The 12-month measurement is achieved either through 4 successive 90-day measurements using gross alpha track radon detectors, as were used during the screening measurement conducted during this EI, or through the use of a long-term measurement device, such as a 12-month alpha-track detector. The average annual concentration in the building then can be used to estimate health risks and as a comparison to established guidance levels on the need for remedial action.

Considering that some of the buildings at the Annex are periodically utilized for training exercises during which ventilation is increased due to the door being open, the 12-month alpha detector would best integrate the actual radon gas concentration in the building interiors under real usage conditions. Placement of detectors at multiple locations in the buildings is also recommended during follow-up long term monitoring. Emphasis should be given to conducting the follow-up monitoring in buildings intended to be utilized by user populations under the usage scenario defined by the potential property transferee.

The average annual concentration in the individual buildings then can be used to reevaluate health risks and as a comparison to established guidance levels on the need for remedial action for those buildings intended for use. No decision on the need for permanent corrective action for radon should be made until completion of such a 12-month follow-up measurement period [U.S. EPA, 1987b].

8.2.4.2 Soil

Literature research indicates that the nitroaromatics present in soil which are the source of the carcinogenic risks are susceptible to photolysis. Soil samples collected during this EI from the igloo areas were all collected after removing an overlying vegetation layer. The presence of the vegetative cover inhibits photolysis of these compounds by preventing their exposure to sunlight. Removal of the vegetative cover, and maintaining the areas around the igloos as denuded soil by periodic rototilling, would facilitate natural photolysis of these compounds. Methods other than rototilling should also be explored to break up soil lumps in order to maximize the surface area to volume ratio, and hence speed the photolysis to completion if remediation of soils is to be undertaken.

Little is known about the rate of photolysis of these nitroaromatic compounds. Prior to undertaking such an in-place photolytic remediation program, further literature or bench-scale research on reaction rates may be necessary in order to ascertain the duration of such a

program. Alternatively, pilot-scale implementation of such an alternative technology program could be implemented, with proper routine sampling to generate empirical data on rates of reaction experienced in the field. Regardless of approach, limited further sampling during remediation (if any is to be undertaken) would be necessary to establish both the horizontal (areal) and vertical extent of soil contamination by these nitroaromatic compounds.

All igloo soil samples during this EI were collected immediately outside the igloo at the discharge point beneath the drainage channel grates affixed to the front wall of the igloo. Each sample submitted for analysis consisted of a composite of two aliquots, one from beneath each grate.

Since no general water service existed at the Annex other than at the bath house, it is unlikely that spillage of powdered materials on the igloo floors were hosed out of the igloos with any frequency. Migration of the contaminants likely occurred through either infrequent flushing of the floors and consequent drainage out the grates, or through sweeping of the floors either into the drainage channels and along the channels to the grates, or along the floors and out the igloo entrance and onto the pad, and then to the soils. The actual means of migration to the exterior soils could dramatically impact the horizontal extent of contamination. Collection of limited samples of soil at various locations in front of the identified igloos is recommended during remediation (if any is to be undertaken) to ascertain the areal extent of soil contamination.

Although literature research indicates the nitroaromatics found in the soils at the site have limited mobility in soil, collection of samples at several deeper depths is also recommended during remediation (if any is to be undertaken). All soil samples collected during the EI were from the 0-6 inch soil profile. Samples from the 12-18 inch, 18-24 inch, and 24-30 inch soil regimes should be collected and analyzed in order to ascertain depth of the soil which needs to be remediated. Depth, and hence volume of contaminated media, along with reaction rates, will weigh heavily on determination of treatment duration.

Alternatively, if remediation of soils is to be undertaken, the soils could be excavated and run through an ultraviolet irradiation treatment train to achieve the desired photolytic reaction. This approach would also be very dependent on size reduction methodology in order to maximize the surface area to volume ratio of the soils fed through the treatment train. This treatment train approach, in contrast to natural photolysis, offers increased control of reaction rates through variation of the ultraviolet irradiation dose. Several irradiation methods are available, including arrays of ultraviolet light banks and solar collectors/concentrators.

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